Fisheries and Oceans Science
Pêches et Océans Sciences

CSAS
Canadian Science Advisory Secretariat

SCCS
Secrétariat canadien de consultation scientifique

Research Document 2001/008

Document de recherche 2001/008

Not to be cited without permission of the authors *

Ne pas citer sans autorisation des auteurs *

Stock Status of Atlantic Salmon (*Salmo salar*) in the Miramichi River, 2000

G. Chaput, D. Moore, J. Hayward, J. Sheasgreen, and B. Dubee[1]

Dept. of Fisheries and Oceans
Science Branch
P.O. Box 5030
Moncton, N.B.
E1C 9B6

[1] New Brunswick Dept. of Natural Resources and Energy
80 Pleasant St.
Miramichi, N.B.
E1V 1X7

* This series documents the scientific basis for the evaluation of fisheries resources in Canada. As such, it addresses the issues of the day in the time frames required and the documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

* La présente série documente les bases scientifiques des évaluations des ressources halieutiques du Canada. Elle traite des problèmes courants selon les échéanciers dictés. Les documents qu'elle contient ne doivent pas être considérés comme des énoncés définitifs sur les sujets traités, mais plutôt comme des rapports d'étape sur les études en cours.

Research documents are produced in the official language in which they are provided to the Secretariat.

Les documents de recherche sont publiés dans la langue officielle utilisée dans le manuscrit envoyé au Secrétariat.

This document is available on the Internet at:
http://www.dfo-mpo.gc.ca/csas/

Ce document est disponible sur l'Internet à:

ISSN 1480-4883
Ottawa, 2001
Canada

Abstract

Atlantic salmon (*Salmo salar*) in the Miramichi River, New Brunswick, were harvested by two user groups in 2000; First Nations and recreational fishers. The Aboriginal food fishery catches in 2000 represented an increase of 43% for small and 32% decrease for large salmon relative to the previous five year means. Harvests of large salmon were 67% from the early-run (prior to Sept. 1) and 90% of the small salmon harvests were taken prior to Sept. 1 in 2000. Recreational fishery catch data for 2000 have not yet been analysed. The Crown Reserve catches increased from 1999 but were among the lowest of the time series. For the Southwest Miramichi, 22600 small salmon and 13100 large salmon were estimated to have returned in 2000. After accounting for removals (so far incomplete), egg depositions in the Southwest Miramichi by both small and large salmon was less than 97% of the conservation requirement. For the Northwest Miramichi, 12900 small salmon and 4700 large salmon were estimated to have returned. Egg depositions by small and large salmon in the Northwest in 2000 will be less than 87% of conservation requirement. Egg depositions had exceeded the conservation requirements in each branch prior to 1998 except for the Southwest Miramichi in 1997. Neither branch achieved conservation requirements in 1998 and 1999. Large salmon returns in 2001 are expected to be between 14700 and 25200 fish with a 54% chance of meeting conservation requirements. The increased and sustained densities of juvenile salmon, since 1985 for fry and 1986 for parr, at the index sites sampled since 1971, indicate that abundance of Atlantic salmon adults of the Miramichi will be similar to recent years unless smolt production increases and / or sea survivals improve.

Résumé

Le saumon de l'Atlantique (*Salmo salar*) de la rivière Miramichi, Nouveau-Brunswick, a été exploité dans les pêches autochtones et dans les pêches récréatives. En 2000, les captures de grands saumons dans les pêches autochtones ont diminué de 32% par rapport à la moyenne des années antérieures tandis que les captures de madeleineaux (<63 cm longueur à la fourche) ont augmenté de 43%. Près de 67% des grands saumons et 90% des madeleineaux récoltés par les autochtones provenaient de la remontée d'été (avant le 1e septembre). Pour la pêche récréative, les données de captures en 2000 n'étaient pas disponibles. Dans la pêche sportive des eaux de réserves de la couronne, les captures étaient améliorées par rapport à 1999 mais elles étaient parmi les plus faibles observées antérieurement. La montaison de saumon dans la rivière Miramichi sud-ouest était de 22 600 madeleineaux et 13 100 grands saumons. Les géniteurs auraient contribué à une ponte d'oeufs maximale de 97% des besoins de la conservation pour la rivière Miramichi sud-ouest. Dans la Miramichi nord-est, la montaison a été estimée à environ 12 900 madeleineaux et 4 700 grands saumons. Les géniteurs de cette montaison auraient contribué une ponte d'oeufs maximale de 87% des besoins de conservation. Avant 1998, les pontes d'oeufs ont été supérieures aux besoins pour les deux affluents principales de la Miramichi, sauf en 1997 pour l'affluent sud-ouest. En 1998 en 1999, la ponte d'oeufs a été inférieure aux besoins de conservations dans les deux affluents. La prévision de la remontée de grands saumons pour 2001 est d'environ 14 700 à 25 200 poissons. Il est probable, à 54%, que la remontée soit supérieure au niveau de conservation. Une amélioration des densités de juvéniles depuis 1985 pour les tacons d'age 0+ et de 1986 pour les plus vieux, a été observée aux sites repères échantillonnées annuellement depuis 1971. Ces augmentations soutenues laissent croire que l'abondance des adultes dans la Miramichi se maintiendra aux niveaux des dernières années dans l'absence d'une production de saumonneaux ou de taux de survie en mer améliorés.

Table of Contents

Abstract / Résumé 2

Introduction 4

Description of Fisheries 5

Conservation Requirement 7

Research Data 8

Estimation of Stock Parameters 9

Status of Stock 14

Ecological Considerations 16

Forecast / Prospects 19

Conclusions and Management Considerations 21

References 23

Tables 26

Figures 44

Appendices 77

INTRODUCTION

The Miramichi River, at a maximum axial length of 250 km and draining an area of about 14,000 km^2, has the largest Atlantic salmon run of eastern North America. There are two major branches: the Northwest Branch covers about 3,900 km^2 and the Southwest Branch about 7,700 km^2 of drainage area (Randall et al. 1989). Smaller tributaries draining into the Miramichi River below the confluence of the two main branches account for the remaining waterhsed area. The two branches drain into a common estuary and subsequently drain into the Gulf of St. Lawrence at latitude 47°N (Fig. 1).

Annual assessments of the Atlantic salmon (*Salmo salar*) stock of the Miramichi River have been prepared since 1982 (Randall and Chadwick 1983a, b; Randall and Schofield 1987, 1988; Randall et al. 1985, 1986, 1989, 1990; Moore et al. 1991, 1992). Since 1992, separate assessments of the Northwest and Southwest branches have been prepared (Courtenay et al. 1993; Chaput et al. 1994b, 1995, 1996, 1997, 1998, 1999, 2000).

Two size groups of salmon return to the river to spawn. The small salmon category consists of fish less than 63 cm fork length and are generally referred to as grilse. These fish have usually spent only one full year at sea (one-sea-winter or 1SW) prior to returning to the river but the size group may also contain some previously spawned salmon. The large salmon category consists of fish greater than or equal to 63 cm fork length. This size group is generally referred to as multi-sea-winter (MSW) or just salmon and contains varying proportions of one-sea-winter, two-sea-winter and three-sea-winter maiden (first time) spawners as well as previous spawners (Moore et al. 1995). Salmon which have spawned and have not yet returned to sea in the spring of the year are referred to as kelts or black salmon in contrast to bright salmon which are mature adult salmon moving into freshwater from the ocean.

In addition to the different runs and size groups, the Miramichi River also contains several stocks of Atlantic salmon (Saunders 1981, Riddell and Leggett 1981). Separate branch assessments were introduced to account for some of this diversity and for the differences in exploitation between the Northwest and Southwest branches. Aboriginal fisheries were historically conducted almost exclusively in the Northwest Miramichi (exploitation also occurs in the estuarial waters of the Miramichi River, downstream of the confluence of the two branches) and recreational fisheries exploitation also differs between the Northwest and Southwest branches.

Temporal stock distinctiveness has also been highlighted as an important component of the Atlantic salmon resource (Saunders 1967). The early-run consists of salmon returning to the river up to August 31 whereas the late-run is considered to consist of salmon returning from September 1 onwards. Early runs and late runs have different composition in terms of small and large salmon proportions and sex ratios. The early runs in both branches are also exploited more heavily than the late runs.

The objectives of the assessment are to estimate the returns of salmon, the spawning escapement after removals and to compare the egg deposition to the conservation requirement for the river. The status of the resource is assessed on the basis of whether the conservation requirement was attained/exceeded, on the trends in returns, the juvenile densities, and the prospects. The returns and escapements are estimated on a spatial and temporal scale corresponding to the available data. Returns by size group to the whole river are partitioned into Northwest and Southwest Miramichi returns and when possible into early and late run. The egg depositions in each branch were estimated by incorporating the variability in run composition (sex ratio and size of fish which determines the fecundity) and the uncertainty in the estimates of escapement. Juvenile surveys provide finer spatial scale assessments of spawning activity in the previous year. Finally, using time series of returns, escapements, and juvenile surveys, we provide a prognosis of the future stock status of Atlantic salmon from the Miramichi River.

Input from industry, user groups and other government agencies was obtained during a science assessment workshop held in Doaktown (NB) on December 1, 2000 (minutes in Appendix 1).

DESCRIPTION OF FISHERIES

A distinction is made between catches and harvests. Catches consist of fish which are caught but not necessarily retained. Harvests represent fish which are caught and retained.

Atlantic salmon were harvested by two user groups in 2000: First Nations and recreational fishers. Aboriginal food fishery harvesting agreements were signed between DFO, the Eel Ground First Nation and the Red Bank First Nation (Table 1). The agreements focused on the selective harvest of small salmon over large salmon through the use of food fishery trapnets. In 1998 to 2000, the Eel Ground First Nation fished one food fishery trapnet in the Northwest Miramichi and two food trapnets in the Southwest Miramichi. A partial counting fence has also been operated at Big Hole Tract for the selective harvest of small and large salmon since 1996 (Table 1). Two food trapnets were fished by Red Bank First Nation at similar locations to previous years (confluence of the Northwest and Little Southwest Miramichi). A communal license was issued to Burnt Church First Nation (Table 1).

There were no changes in recreational fishery regulations in 2000 relative to 1999 (Chaput et al. MS2000) (Table 2). The daily retention limit of one small salmon introduced in 1998 was maintained and there was no change in the season limit of 8 kept fish for the year. There was mandatory catch-and-release of all large salmon, as has been the case since 1984, with a maximum daily catch-and-release limit of four fish, regardless of size. Fishing for the day was to cease when either one small salmon was retained or four fish of any size were hooked and released. There were not any river-wide restrictions on angling due to low water conditions and warm temperatures in 2000.

Aboriginal Food Fisheries

With the exception of the Burnt Church fishery, which occurred in estuary waters of Miramichi Bay, large salmon harvests were exclusively from the Northwest Miramichi (Table 3). Small salmon harvests (preliminary) were divided 73% from the Northwest Miramichi and 27% from the Southwest Miramichi River. Perliminary estimates of harvests (excluding gill nets) from food fisheries in the Northwest Miramichi in 2000 were 274 large salmon and 2502 small salmon. A total of 451 small salmon were harvested from the Southwest Miramichi. The harvests reported in Table 3 are exclusive of those taken from waters specified in the Aboriginal Communal Fishing licenses.

The Aboriginal food fishery harvests in 2000 represented an increase of 43% for small salmon and a decrease of 32% for large salmon relative to the previous 5-year mean.

The Eel Ground First Nation did not harvest any large salmon from the food fishery trapnets but harvested 36% of the small salmon catch. The Red Bank First Nation harvested 43% of the large salmon catch and 92% of the small salmon catch. The food fisheries mainly targeted the early run for small salmon (90% of harvests were taken prior to September 1) and 67% of the large salmon were harvested from the early-run.

Recreational Fisheries

Angling catch data have in the past been available from two sources: FISHSYS from the New Brunswick Department of Natural Resources and Energy (DNRE), and from the Government of Canada Department of Fisheries and Oceans (DFO) (Moore et al. MS1995). For the Miramichi River system, the DNRE estimates are considered to be more accurate than the DFO estimates (Randall and Chadwick MS1983a). DFO estimates of catch, which have generally been lower than the DNRE estimates, were not collected after 1994.

The FISHSYS survey was not conducted in 1996. FISHSYS catch data for 1998 were not available to date. In 1999 and 2000, catch report cards were included with the tags as a means of obtaining catch and effort data from the recreational fishery. There was little promotion of the program and low compliance in 1999 due in part to the lateness of the decision to include the voluntary report card. The data entry of returned cards for 2000 is ongoing. There is a likelihood that the catch report cards will be attached to the license in year 2001 and more extensive publicity of the new reporting system will be undertaken.

On average (1991 to 1995), 13284 small salmon were harvested, 4666 small salmon were released and 6404 large salmon were released during the bright salmon fishery (Fig. 2). The Southwest Miramichi represented 67% of the catch of small salmon and 75% of the large salmon catch. Large salmon catches (kept and released) in the Miramichi peaked in 1986 and declined to 3146 salmon in 1995 (Fig. 2). Small salmon catches have fluctuated annually, having peaked in 1989 at almost 31000 fish and declining to 5622 in 1995. The catches of small and large salmon increased the most in the Northwest Miramichi since the closure of commercial fisheries and the introduction of hook and release angling in 1984 (Fig. 2). Catches of large salmon in the Southwest Miramichi decreased after 1986 and declined to less than 2600 fish in 1995. Catches in 1995 were abnormally low because of numerous closures resulting from warm and low water conditions (Chaput et al. MS1996).

The Crown Reserve waters of the Northwest Miramichi are regulated in terms of effort and catches in these waters represent the best indicator of relative availability and abundance of salmon from the early-run component in the Northwest Miramichi. Total effort in 2000 (2,619 rod days) was the highest since 1981 (Fig. 3). Catches of small salmon and large salmon were above 1999 but remained among the lowest of the time series (Fig. 3). At the workshop in December 2000, attendees indicated that fish were not in the river as early in 2000 as in 1999 but fishing conditions and success were good to very good in July and early August and into the fall (Appendix 1).

A catch and release mortality of 3% is assumed to result from salmon angling activities for the Miramichi, similar to previous assessments. This value is applied to both small salmon and large salmon.

Summary of fisheries removals

Aboriginal fisheries in the Northwest Miramichi account for the majority of large salmon removed, on average 72% of the annual total. In the Southwest Miramichi, there are no aboriginal fisheries for large salmon and all the removals are attributed to the angling fishery, resulting from catch and release mortality. Overall in the Miramichi, aboriginal fisheries have accounted for 55% of the large salmon removals while angling accounts for 45% of the fisheries losses. For small salmon, the angling fishery has on average removed the majority of fish in both the Northwest (78%) and Southwest (97%) branches and overall in the Miramichi River (87%).

Illegal removals/seizures

A total of 29 small salmon and 1 large salmon were seized as a result of illegal fishing activities in 2000, essentially unchanged from recent years.

Broodstock collections

In 2000, a total of 113 large salmon and 75 small salmon were collected and spawned at the Miramichi Salmonid Conservation Centre (Table 4). Collections were made from specific tributaries and the number of fish removed corresponded to the intended stocking intensity at the specified locations. The collections in 2000 are the highest of the last four years and were similar to the quantities of fish collected for the hatchery prior to 1997.

Disease losses

Atlantic salmon mortalities collected and sent to the DFO Fish Health Unit confirmed the presence of *Aeromonas salmonicida* (furunculosis causing bacteria) from fish in both branches of the river in 2000. Mortalities were fewer than in previous years with only 7 confirmed cases in the Miramichi System in 2000, compared to 13 in 1999. There were no changes in the number of mortalities at the DNRE protection barriers in 2000; mortalities were minimal and comparable to those of previous years. *Vibrio*, another bacterial disease causing occasional mortalities in wild salmon, was detected in 1999 but not in 2000.

Other observed mortalities

Mortalities associated with warm water conditions were minimal in 2000 compared to 1999. During the week of June 18 to 26, six dead salmon were reported while in the first week of August, three dead salmon were reported. Although mortalities are reported every year, warm water temperatures may have resulted in a greater loss in 1999 and low water conditions may have contributed to an enhanced visibility of carcasses. A total of nine fish which had previously been tagged at the estuary trapnets were recovered on dead fish upriver (Table 5; Appendix 2). Very few tags from dead fish have been recovered in previous years and no tags from dead fish were returned in 2000.

CONSERVATION REQUIREMENT

The conservation spawning requirement for the Miramichi River and each branch separately is based on an egg requirement of 2.4 eggs/m^2 of spawning and rearing habitat area (CAFSAC 1991). Habitat area estimates are from Amiro (1983). The objective is to obtain all the egg depositions from large salmon. Fish required are calculated using the average biological characteristics of the Miramichi stock. The small salmon requirement is to provide a theoretical 1:1 sex ratio. The spawning requirements in terms of fish were based on the average biological characteristics of salmon during 1971 to 1983: 86% female and a fecundity of 6816 eggs per female resulting in an average of 5862 eggs per large salmon spawner, 75% male for the small salmon (Randall MS1985).

	Habitat area (million m^2)	Egg requirement (millions)	Fish required	
			Large salmon	Small salmon
Miramichi River	54.6	132	23,600	22,600
Main Miramichi	1.1	3	554	531
Southwest Miramichi	36.7	88.1	15,730	15,063
Northwest Miramichi	16.8	40.3	7,316	7,006

Point estimates of the required number of spawners ignore the annual variation in fecundity and the female proportion of the large salmon returning to the Miramichi River. It has been shown that fish returning to the Miramichi since 1984 are larger than prior to 1985 (Moore et al. 1995). Larger fish contribute more eggs which results in fewer fish required to achieve the conservation egg requirements. Based on the biological characteristics of salmon from 1992 to 1996 (corresponding to the most recent significant change in management, the moratorium in the insular Newfoundland commercial salmon fishery), the spawning requirements in terms of fish for the Miramichi are reduced to 21800 large salmon and 21095 small salmon (averaging 86% male). There is no change in the egg requirement.

RESEARCH DATA

Data collected in 2000 are similar to previous years and pertain to the estimation of returns, size distribution, sex ratios, abundance of juvenile salmon, and hatchery stocking. Returns are estimated from mark and recapture experiments. The size distribution and sex ratio data are collected at the tagging and recapture trapnets, from food fishery trapnets and from broodstock seining operations. The abundance of juvenile salmon is estimated from electrofishing surveys.

Estimation of returns

Trapnets were operated below head of tide in both branches of the Miramichi River (Fig. 1). Details of trapnet construction are provided in Chaput et al. (MS1997). The food/science trapnets operated by Eel Ground First Nation (one in the Northwest, two in the Southwest) upstream of the confluence of the Southwest and Northwest branches of the Miramichi River were the main tagging trapnets. An upstream trapnet on the Southwest Miramichi (Millerton, Fig. 1) was used for tagging and recapture. The Red Bank trapnets were the main recapture gear for the Northwest Miramichi. In 1998 to 2000, a trapnet (Cassilis) installed about 5 km below the Red Bank trapnets served for both tagging and recapture of downstream tags. The trapnets were fished once a day at slack tide, sometimes twice a day at Red Bank. The dates of operation, total fish caught, and total tags released, by size group, are summarized in Table 6. In addition, salmon were sampled at the partial fence at Big Hole tract in the Northwest Miramichi.

Salmon were marked with individually numbered blue Carlin tags (dimensions 9.5 mm by 4.6 mm by 1.0 mm thick) attached to the back just anterior to the dorsal fin with narrow gauge stainless steel wire. Fork length and external sex determination (fall period) were obtained from all salmon at the tagging trapnets. Scale samples, for determination of age, were removed from the standard location (along the imaginary line joining the posterior of the dorsal fin and the anterior of the anal fin, two to four rows above the lateral line) from all large salmon and from every second small salmon. Scale samples were stored dry.

Food fishery catches at Eel Ground and Red Bank were sampled for number of salmon caught (by size) and number as well as sex of salmon harvested (by internal examination). Almost all the large salmon from the Eel Ground trapnets were tagged before being released (Table 6). The number of tags placed and the time and location of recaptures, by size group and month, at each of the tagging facilities in 2000 are summarized in Appendix 2.

Recaptured fish at all trapnets were sampled for the tag number, size (small or large), date and trapnet location before being released or when harvested in the food fisheries.

Daily counts of salmon, by size, were obtained at several barrier fence and counting fence facilities within the Northwest and Southwest Miramichi (Fig. 1). Tag numbers of marked fish passing through these barriers were recorded prior to release upstream. Broodstock seining also provided samples of size, number of fish, tag numbers of marked fish, and sex ratios.

Juvenile Surveys in the Miramichi River

Electrofishing surveys were conducted at 70 sites (32 in the Northwest Miramichi and 38 in the Southwest Miramichi) between August 1 and October 13, 2000. Thirteen of these sites have been sampled every year since 1970. Densities (number of fish per 100 m^2) of juvenile salmon were estimated at a combination of open (64 in total) and closed (6 in total). At closed sites, a section of the stream was enclosed by fine mesh barrier nets, the enclosed area was fished with the shocker from bank to bank in a downstream direction a minimum of 3 times, and densities were estimated by the removal method (Zippin 1956). At the open sites, juvenile abundance was estimated from catch per unit effort (CPUE). Fishing was conducted from bank to bank in an upstream direction, with 3 people: one person with the shocker unit, a second with a seine (1 meter wide by 0.75 meters high), and a third with the fish holding bucket and dip net. The amount of fishing effort was recorded from a timer on the shocking unit and represented the total seconds of actual shocking time. CPUE was transformed to density by calibrating the open site technique within closed sites using all age groups combined (see Chaput et al MS 1995). Results from calibrations made in 2000 are given in Appendix 3.

Fish were anesthetized, using sodium bicarbonate salts, identified to species, measured for length (fork length), and weight. Large eels were counted but not measured and large catches were subsampled with at least 30 individuals of each age group of a species being measured and weighed. Percent habitat saturation value (PHS) were calculated for each site (Grant and Kramer 1990).

ESTIMATION OF STOCK PARAMETERS

Estimation of Returns

Returns are estimated to each branch and to the Miramichi River. The tagging and recapture matrices are summarized in Table 7. Because of the sufficient number of recaptures, returns were estimated separately for small and large salmon. In 1997 and 1998, the tagging and recapture matrices were the combined data for small and large salmon and the returns of small and large salmon were estimated using the ratio of small salmon and large salmon in the total recapture trapnet samples. Emigration of tagged fish between the branches is accounted for in the spatially stratified model (Darroch or Schaeffer). Estimates were obtained using the Darroch (Arnason et al. 1996), Schaeffer and Peterson models (Ricker 1975).

The uncertainty around the estimation of returns in the spatially stratified model consists of two components:

1 - Random variation in the tag loss/tag mortality factor was incorporated as a uniformly distributed function between 0% and 20% (mean of 10%).

2 - Uncertainty in the temporally-stratified recapture matrix was estimated by resampling within the rows of the observed matrix of recaptures at the trapnets. In this case, the prior probabilities for a marked fish in the catches at the trapnets was set at the observed proportion for each tag release stratum. Recoveries were assigned to one of the temporal and branch strata (movement of tagged fish among recovery strata) based on the observed distribution of recoveries.

Returns to each branch were obtained using a resampling technique:
Step 1: select a tag loss/tag mortality factor and define recapture matrix.
Step 2: calculate returns using Schaeffer, Darroch and Petersen, save result.
Step 3: repeat steps 1 and 2 a large number of times (1000 replications were performed)
Step 4: summarize distribution of returns from step 3.

Only marks placed up to and including Oct. 15 are considered to be available for recapture. Tagging in the Southwest finished on Sept. 29 while in the Northwest, the last day of tagging was Oct. 15. The recapture trapnets in the Northwest Miramichi fished until Oct. 5 and the Millerton trapnet on the Southwest Miramichi fished until Oct. 20. Returns are estimated up to the point of the recapture trapnets in each branch (would exclude harvests which occurred downstream of each recapture trapnet) and constitute the returns up to and including Oct. 15. Total returns are obtained by adding downstream removals.

At the recapture traps, both the previously marked fish and the unmarked fish are known without error but the marks available for recapture are not.

1 - As in previous years salmon with tagging scars were recorded at the tagging trapnets in the Red Bank trapnets and the marking trapnet in the Southwest Miramichi. The tags may have been shed or could have resulted from anglers removing tags and releasing the fish. This would necessitate a fall-back to tidal waters of angled fish which has been observed in 1995, 1996 and 1997 with the capture of salmon with artificial flies embedded in the jaw. Since all fish at the trapnets are examined for tags and tagging scars, recaptures were considered known without error.

2 - Mortality of tagged fish resulting from tagging and handling has not been estimated although there have not been any recorded mortalities of tagged fish held in hatchery facilities (Chaput et al. MS1994a, Courtenay et al. MS1993). In previous years, dead fish with tags were reported upriver of the recapture trapnets therefore some mortality of tagged fish is assumed to occur although it is not known how many would have died before being available for recapture in the trapnets. In the absence of survival rate data, a combined tag loss/tagged fish mortality factor of 10% was assumed (varying between 0% and 20%), similar to previous assessments (Randall et al. 1989).

Model Results

The population estimates for the entire Miramichi River and for each branch differ among the three models considered. The Peterson model provides an estimate of returns to the entire Miramichi whereas the Darroch and Schaefer models provide branch estimates and total river estimates. The estimates using the Peterson model are generally lower than those of Schaefer which are lower than those of the Darroch model. The confidence intervals are widest for the Darroch model and narrowest for the Peterson estimate. The higher estimates and wider confidence intervals of the Darroch model are the direct result of allowing capture and recapture probabilities to differ among the branches and because of fewer recaptures in each of the branch cells of the recapture matrix.

Studies have indicated that the Schaefer model is unbiased if there are either constant tagging rates or constant recovery rates (in temporal stratification, this would mean either constant tagging proportion or constant recapture probabilities in early and late runs) (Arnason et al. 1996). Under these conditions, the authors indicated that the pooled Peterson estimator is also unbiased and more precise (because it uses the aggregated recaptures) and it is possible to form estimates for both initial and final stratum sizes using simple ratio arguments (Warren and Dempson 1995). The Darroch estimate reduces bias when rates are not constant and it will be less biased but also less precise than the pooled Peterson when the probability of capture or recapture varies but the unbiasedness outweighs the loss of precision (Arnason et al. 1996).

The Schaefer model is attractive because it always gives apparently plausible results (i.e. estimates of population size always greater than zero). The Darroch model will also find a solution but the recapture probabilities (trapnet efficiencies in this case) may be greater than unity such that negative estimates are obtained in some cells. In these cases, there is insufficient information in the data (for example, recaptures in strata frequently 0 or less than 5). Arnasson et al. (1996) concluded that the Schaefer model is not robust to any source of assumption violation.

The overall estimate to the river did not differ substantially among the models for 2000 but the branch estimates were very different. The Schaefer model gave returns of small salmon and large salmon to the Northwest Miramichi of similar magnitude to those of the Southwest Miramichi, even though the Southwest Miramichi is twice the size (Figures 4a and 4b). The Darroch model produced estimates of returns to the Southwest Miramichi returns of about twice those of the Northwest Miramichi. The same differences were observed for the 1999 estimates (Figures 5a and 5b).

Branch estimates from the Schaefer model are positively correlated (R = 0.51 for large salmon, R = 0.62 for small salmon) because the Schaefer model simply redistributes the total returns (estimated from the total recaptures, marks placed and catches) within the strata cells. For the Darroch model, negative estimates of large salmon in the Northwest Miramichi are associated with large positive values for the Southwest Miramichi (R = -0.93). When there is lots of information in the data, such as for small salmon, there is no correlation between the branch estimates of the Darroch model (R = -0.13). The results from the Darroch model are a more honest indicator of what we know about population size of salmon in each branch.

The population estimates from the Darroch model using a season-aggregated matrix were carried forward in the assessment. For consistency with the approach used in 2000, the estimates for 1999 were revised from those of the previous assessment (Chaput et al. 2000) using the same model and matrix aggregation. The revised estimates result in a redistribution of fish between the branches and an increased return overall of both size groups.

Returns to the Southwest Miramichi in 2000

Large salmon returns to the river at the point of the recapture trapnets were estimated at 13,050 fish with a 95% probability that the returns were at least 6,600 fish (Fig.5a). Small salmon returns were estimated at 22,100 fish with a 95% probability that the returns were more than 16,200 fish (Fig. 5b).

Revised values for 1999 are: 11,500 large salmon (95% probability > 6,500 fish) and 13,800 small salmon (95% probability > 10,800 fish). These represent an increase of 69% for large salmon and 30% for small salmon from the previously reported values (Chaput et al. 2000).

The overall efficiency of the Millerton recapture trap for both size groups combined in 1999 and 2000 was just over 6%. Large salmon efficiencies of 3% to 4% were lower than in previous years and trapnet efficiencies for small salmon have varied between 7% and 8%.

Southwest Millerton Trapnet Efficiency							
	2000	1999	1998	1997	1996	1995	1994
Small salmon	7.2%	7.3%			7.5%	7.7%	7.9%
Large salmon	3.3%	4.1%		6.7%	4.8%	8.8%	6.9%
Combined	6.4%	6.3%	5.5%				

Total returns to the Southwest Miramichi (including harvests downstream of the recapture trapnets) were 23,000 small salmon and 13,100 large salmon (Table 8).

Returns to the Northwest Miramichi in 2000

About 4,500 large salmon returned to the Northwest Miramichi in 2000 but the lower limit of the confidence interval from the Darroch model was less than zero (Fig. 5a). Small salmon returns were estimated at 12,600 fish with a 95% probability that the returns were at least 10,000 fish (Fig. 5b).

Revised estimates for 1999 are: 4,500 large salmon (95% probability > 900 fish) and 10,200 small salmon (95% probability > 5,200 fish) (Fig. 5a, 5b). These represent a decrease of 31% for large salmon and 10% for small salmon from the previously reported values (Chaput et al. 2000).

The Red Bank trapnets (two sets) in 1999 and 2000 had the highest ever estimated efficiencies. A trap design similar to the downstream marking trapnet was used in 1999 and 2000 and there were no major washouts or lost days due to high water in 2000.

Northwest Red Bank Trapnet Efficiencies							
	2000	1999	1998	1997	1996	1995	1994
Small salmon	17.5%	14.5%			4.1%	6.5%	6.7%
Large salmon	14.2%	13.6%		5.3%	4.5%	5.6%	3.9%
Combined	16.7%	14.2%	3.3%				

The efficiencies of the marking trapnet (Northwest Cassilis) have varied around 9% for small salmon, 7% for large salmon, and between 8% and 10% for both size groups combined

Northwest Cassilis Trapnet Efficiency			
	2000	1999	1998
Small salmon	9.6%	8.7%	
Large salmon	7.0%	6.6%	
Combined	9.1%	8.1%	10.4%

Total returns to the Northwest Miramichi (including harvests downstream of the recapture trapnets) were 13,000 small salmon and 4,700 large salmon (Table 8).

Returns to the Miramichi River in 2000

In 2000, an estimated 18,000 large salmon and 35,000 small salmon returned to the Miramichi River (Fig. 5c, 5d). There was a 95% chance that returns of large salmon to the Miramichi were at least 12,000 fish and small salmon returns were at least 28,000 fish (Fig. 5c, 5d).

Revised estimates for 1999 are: 16,000 large salmon (95% probability > 12,000 fish) and 25,000 small salmon (95% probability > 20,000 fish) (Fig. 5c, 5d). These represent increases of 19% for large salmon and 14% for small salmon from the previously reported values (Chaput et al. 2000).

Total returns to the river including harvests below recapture trapnets were 36,000 small salmon and 18,200 large salmon (Table 8).

Estimation of Egg Contributions in 2000

The egg contribution in 2000 was calculated for the returns to river only, since the removals data are incomplete.

Escapement in 2000

The escapement of salmon refers to fish which were not harvested in fisheries or otherwise removed from the river. Removals also include broodstock collections, scientific sampling, and incidental mortalities at the tagging trapnets, seizures in nets and reported mortalities in the river.

To date, only part of the total removals in 2000 are known.The known removals from the Miramichi River, excluding the angling harvests, total 3,084 small salmon and 427 large salmon (Table 5). Total removals exclusive of angling in the Northwest Branch were 2,568 small salmon and 319 large salmon whereas Southwest Branch removals were 516 small salmon and 108 large salmon.

The large salmon removals in the angling fisheries have in previous years (1992-1997, excluding 1996) totalled 218 fish (Chaput et al. 2000). In the Northwest Branch, losses have averaged 60 large salmon and in the Southwest Branch, losses have average 158 large salmon. Losses in 2000 are expected to be of the same relative order of magnitude.

Biological Characteristics of Salmon in 2000

The majority of large salmon were female in both the Northwest and Southwest branches (Table 9). The percent female (73%) observed in 2000 for the Miramichi River was the lowest value since 1985 (Fig. 6). The percent female in the small salmon size group was average (Table 9, Fig. 6). There tends to be a higher proportion female in the small salmon from the early run, especially in the Northwest Miramichi where 28% of the early-run small salmon were female compared with 9% in the fall run (Table 9).

Based on length and proportions at length from recent years, 32% of the large salmon were estimated to have been previous spawners (Table 9). There was a slightly higher percentage of previous spawners in the Southwest Miramichi (33%) than in the Northwest Miramichi (30%).

Egg contributions in 2000

Large salmon accounted for 80% of the total eggs (122 million eggs) in the returns to the Miramichi River in 2000 (Table 10). In the Southwest Miramichi, large salmon contributed 84% of the 86 million eggs while in the Northwest Miramichi, large salmon contributed 70% of the 35 million eggs (Table 10). In 2000, one large salmon returning to the Miramichi River contributed the equivalent number of eggs of about eight small salmon (Table 9; Fig. 6). For the Northwest Miramichi, just over six small salmon were equivalent to one large salmon while in the Southwest Miramichi, more than nine small salmon would have been required to equal the egg contribution of one large salmon (Table 9).

STATUS OF STOCK

The point estimate of the eggs in the returns of large salmon to the **Miramichi River** (sum of Northwest and Southwest Miramichi branches only, exlcuding main Miramichi below confluence) was 76% of conservation requirements with a 20% chance of having exceeded the conservation requirement of large salmon (Table 10, Fig. 7). Egg depositions by both small and large salmon returns (before harvests) equalled 95% of requirement, with a 41% probability of having exceeded the conservation egg requirement (Fig. 7). Actual egg depositions would be lower because of the expected loss of as much as 50% of the small salmon returns to the river. Since the 1984 management plan, small salmon have contributed on average 22% of the total egg deposition, the most important contribution by small salmon occurred in 1981 at 58% (Fig. 8). Since 1997, returns of small salmon and large salmon have been below or around conservation requirement.

Returns and escapements of small salmon to the Miramichi peaked in 1992 and have since declined to about 23,000 to 36,000 small salmon over the last four years (Table 11, Fig. 9). The return in 2000 of 35,600 small salmon was a 39% increase from 1999 but 28% below the previous 5-year average return to the river (Table 11). The large salmon returns since the closure of the commercial fisheries peaked in 1992. The return in 2000 of 18,200 large salmon is the fifth lowest since 1984 and was 20% below the previous 5-year average (Table 11; Fig. 9). The return in 2000 was a 12% increase from the return of 1999.

Returns of large salmon to the **Southwest Miramichi** would have contributed about 72 million eggs, equivalent to 84% of the conservation requirement. Returns of small salmon and large salmon combined would have equalled 97% of requirement (Table 10) with a 47% chance of having met the conservation egg requirement (Table 10, Fig. 7). This is the fourth consecutive year that conservation requirements

have not been met. Egg depositions exceeded the conservation requirements between 1992 and 1996 (Fig. 8). Returns to the Southwest Miramichi have declined since 1992 (Table 12).

In the **Northwest Miramichi**, the 25 million eggs contributed by the returns of large salmon represent 70% of the conservation requirement (Table 10). The contribution which would have been made by the small salmon returns would have increased the egg depositions to 87% of requirement with a 36% chance that conservation egg requirements were met in 2000 before accounting for removals (Fig. 7). This is the third consecutive year that egg potential in the returns were less than the conservation requirements (Fig. 8). Returns to the Northwest Miramichi have declined since 1995 (Table 12).

Barrier and Counting Fences

Large salmon and small salmon have been enumerated at headwater barrier fences on the Southwest branch (Juniper Barrier on the North Branch of SW Miramichi, Dungarvon River) since 1981 and on the Northwest branch (Northwest Miramichi River) since 1988 (Fig. 1; Table 13). Additionally small and large salmon are enumerated at research oriented counting fences on Catamaran, Clearwater , and Burnthill brooks (Fig. 1, Tables 14 and 15). The fences are operated for varying periods each year but generally cover the entire migration period.

The salmon returning to the barrier fences and counting fences are a mixture of early and late run components. The North Branch Southwest Miramichi Barrier, the Dungarvon Barrier, and the Northwest Miramichi Barrier are in the headwaters of the system and salmon returning to these are predominantly early-run salmon, i.e. they were in the tidal waters of the river prior to August 31 (Fig. 10). The Clearwater Brook and Burnthill Brook counting fences in the Southwest Miramichi are utilized by a mixture of early-run and late-run fish (Fig. 10). Catamaran Brook is utilized predominantly by late-run salmon (Fig. 10).

Counts of large salmon in 2000 at the Dungarvon barrier fence were down 12% from the previous 5-year mean and counts of small salmon were down 18% (Table 13). At the North Branch (Juniper) Barrier, counts of small salmon were up 39% from the five-year average, while large salmon were down slightly (3%) from the average (Table 13). The count of large salmon at the Clearwater Brook counting fence in 2000 was down 52% relative to 1999 while small salmon counts were up 7% (Table 14).

Returns of large salmon at the Northwest Barrier were 16% below the previous 5-year average and small salmon counts were the lowest ever (Table 13). The counts at Catamaran Brook, a mainly fall-run tributary, were the lowest ever for large salmon and 33% below the previous five-year average for small salmon (Table 15).

Summary of Returns and Indices

Overall, returns of small salmon were improved from 1999 in the Southwest Miramichi at three of the four monitoring facilities. Large salmon in the Southwest Miramichi were up slightly from 1999 at two of the four facilities and down substantially at the other sites. Relative to the previous five-year average levels, small salmon numbers declined at one in-river (i.e. upstream of the estuary) counting facility, increased at a second in-river facility, and were unchanged at a third facility in the estuary. Relative to the previous five years, large salmon numbers were basically unchanged.

In the Northwest Miramichi, small salmon returns were down from the previous five-year average at all facilities and down from 1999 at the in-river monitoring sites. Large salmon abundance was down from the previous five-year average and down at the in-river monitoring sites relative to 1999.

	Change in 2000 relative to previous year(s)			
	Small Salmon		Large Salmon	
	1999	1995 - 1999	1999	1995 – 1999
Northwest Miramichi				
Northwest Barrier (early)	-36%	-33%	-44%	-16%
Catamaran Brook (late)	-25%	-33%	-73%	-77%
Trapnet estimate (early & late)	+17%	-8%	0%	-36%
Southwest Miramichi				
North Branch – Juniper (early)	+112%	+39%	+4%	-3%
Dungarvon Barrier (early)	-2%	-18%	-30%	-12%
Clearwater Brook (early & late)	+7%		-52%	
Trapnet estimate (early & late)	+57%	-1%	+14%	+5%

The continued low abundance of large salmon in 2000 was not unexpected given the low returns of small salmon since 1997. The late-run returns were again lower in 2000 for both small salmon and large salmon than during 1994 to 1996 (Figures 11a and 11b). Between 1994 and 1997, catches of large salmon at the trapnet in the Southwest Miramichi were distributed about 25% early (May to August) and 75% late run (September and October). In 1998, the late-run represented only 55% of the total fish sampled (Fig. 11a). In 1999 and 2000, the fall run of large salmon represented 47% and 52%, respectively, of the total catch and only 37% to 39% of the small salmon catch occurred after August 31 (Fig. 11a). At the Cassilis trapnet in the Northwest Miramichi during 1998 and 2000, the small salmon and large salmon catches by August 31 were 65%-69% and 52% to 48%, respectively, of the total catch for the year (Fig. 11b). In 1999, the early spring may have contributed to a large number of late-run fish returning earlier to the river with 90% of the small salmon catch and 77% of the large salmon catch had occurring by August 31 (Fig. 11b).

ECOLOGICAL CONSIDERATIONS

Seasonal and Environmental Conditions

Average monthly daily discharge profiles for 1995 to 2000 are shown in Figure 12. Flows in May of 2000 were the lowest of the last six years but flows in July were greater than in 1998 and 1999 which contributed to good angling conditions in early summer. Flows were median in August and decreased into September and October when they were among the lowest of recent years.

Water temperatures were generally cooler in 2000 than in 1999 (Fig. 13a,b). Temperatures greater than 27°C occurred on several occasions in 1999 but no temperatures above 27°C were recorded in 1998 and 2000 at the main Southwest Miramichi and Little Southwest Miramichi sites. Periods of highest temperatures generally occur during mid-July to mid-August (Fig. 13a,b). Warmest water temperatures were recorded in the afternoon and evening, maximum temperatures occurred between 14:00 and 20:00 in all three years.

Spawner Distribution and Habitat Utilization

In 1999, spawning occurred throughout the Northwest and Southwest Miramichi (Fig. 14). Fry densities were high (> Elson norm of 29 per 100 m²) at 18 of the 32 sites sampled in the Northwest

Miramichi and at 32 of the 38 sites sampled in the Southwest Miramichi (Fig. 14). Low densities (< 10 fish per 100 m^2) or no fry were observed at only 4 of the 70 sites in the entire system. Spawning distribution has been monitored using this method since 1993 and results indicate that spawning occurred throughout the basin accessible to Atlantic salmon.

Parr densities (age 1 and older) were high (above Elson norm of 38 per 100m^2) at 12 of 32 sites in the Northwest Miramichi and 8 of 38 sites in the Southwest Miramichi (Fig. 14). Low parr abundances (< 10 per 100 m^2) were observed at 19 of the 70 sites sampled in 2000; 8 of the 32 sites in the Northwest Miramichi and 11 of 38 sites in the Southwest Miramichi (Fig. 14).

Fry densities in the Southwest and Northwest in 2000 were down from the unusually high levels of 1999 (Fig. 15, 16). High fry densities in 1999 were not expected because of the low estimated escapement of salmon in 1998 which were estimated to have been the lowest of the last ten years. Increased abundance of fry and parr in 1999 was considered to have been an artifact of low water levels which reduced habitat and resulted in higher densities of fish at the sampling sites, and/or improved inter-stage survival from recent years. Median fry levels in 2000 in the Northwest Miramichi and the Southwest Miramichi were the lowest since 1993 whereas parr levels were similar to those of 1992 to 1998 (Fig. 15, 16).

Percent habitat saturation (PHS) index is a relative measure of the habitat use and potential interaction between juveniles within the stream. It considers both the densities of fish and body lengths. A PHS value of 28 is used as a reference point; it represents the value at which density dependent effects have a 50% probability of being expressed (Grant and Kramer 1990). The median PHS values in the Northwest Miramichi and the Southwest Miramichi in 2000 were below 28 but median values in each branch have fluctuated around 28 during the last six years (Fig. 17). PHS values in excess of 28 were estimated at more than 25% of sites in both branches of the river.

Size of juveniles

Mean sizes-at-age, standardized to the average sampling date of the time series (1970 to 1999 (August 14) and to a common density (average of the time series) show important annual variations (Fig. 18). Size-at-age of fry in the Southwest Miramichi are generally greater than those of the Northwest Miramichi and were highest in both branches in the early 1970s and mid 1980s (Fig. 18). Annual variation in mean fork length was as much as 1.5 cm, equivalent to 30% of the overall average. Exceptionally small sizes-at-age of fry were observed in 1978 and 1981 in the Northwest Miramichi. Since 1995, the mean size-at-age of fry has been increasing in both branches and in 2000, mean size-at-age of fry was the largest of the last thirteen years (Fig. 18).

For age-1 year parr, the largest sizes were observed in the early 70s and in the late 1980s and the smallest sizes were observed in the late 1970s and 1990s (Fig. 18). As with fry, age-1 parr from the Southwest were generally larger than in the Northwest. In the last ten years, the smallest size-at-age for age-1 parr was observed in 1997 and 1998 with sizes in 2000 the largest. Annual variation in mean size was 1.5 cm as well representing extremes in size of 18% of the overall mean size.

Age-2 parr were the largest in the early 1970s and smallest through the late 1970s and early 1980s and again in the 1990s (Fig. 18). Annual variation in mean size was 1.7 cm representing extremes in size of 15% of the overall mean size.

There are two factors suspected of affecting juvenile salmon growth in the Miramichi: density of juveniles and conditions for growth (water temperatures and food). There is a negative relationship

between size-at-age and density of juveniles in the Miramichi River although it explains only a small proportion of the mean annual variation in size (less than 10%). It is difficult to partition the potential effect of density and environmental conditions since the high densities of juveniles have occurred concurrently with warmer water temperatures in recent years. The association between mean size-at-age and environmental conditions is currently being explored.

Size of adults in 2000

Adults returning to the Miramichi in recent years have been the largest at age for the 28 year time series (Fig. 19). The mean lengths of both age groups in both seasons in 1999 remained well above those of the time series. The abrupt change in size-at-age after 1985 has been attributed to size-selective fisheries on both the 1SW and 2SW salmon which occurred in the early period (Moore et al. 1995). For 1SW salmon, the mean lengths in the summer and fall runs of 1999 were significantly greater ($P < 0.01$) by at least 1.3 cm than in all previous years. The differences were greater in the summer run 1SW salmon. For 2SW salmon, the average lengths of summer fish in 1999 were significantly greater ($P<0.01$) than all other years except for 1987 (Fig. 19). Fall run 2SW salmon in 1999 were also larger than recent years but not significantly different ($P > 0.05$) than 2SW salmon of 1976 and 1979 (Fig. 19).

For 2000, ageing is not complete but the small salmon continued to be generally of larger body size although shorter than those of 1999 (Fig. 20). The larger bodied small salmon of the last four years correspond to low returns of small salmon to the Miramichi. A very strong size-selective mortality function could account for the association between body size and abundance. Alternatively, the low abundance of salmon and large body size may simply be coincident with good growth conditions at sea and reduced smolt production under variable sea survival. The hypotheses remain to be explored.

FORECAST/PROSPECTS

Expectations for large salmon in 2001

Previous assessments presented a forecast model for large salmon returns based on a relationship with small salmon returns in the preceding year for the time series starting in 1970 (Claytor et al. 1991, Claytor et al. 1992). Its performance was poor in recent years (Chaput et al. 2000).

The association between small salmon (almost exclusively 1SW salmon) and large salmon returns the subsequent year was examined over a shorter time series, 1985 to 2000 (Figure 21). The ratio of small salmon to large salmon for this time period varied between 1.4 and 7.1 with the most recent year ratio (1999 small, 2000 large salmon) at 1.41. The median ratio model for the recent five-year period (1995 to 1999) would predict returns of large salmon (including previous spawners) between 14,700 and 25,200 fish.

	Miramichi	Northwest	Southwest
Returns of small salmon in 2000	35,600	12,900	22,600
Large salmon returns in 2001 (ratio)			
Median	16,400	4,800	11,200
	(2.18)	(2.70)	(2.01)
Minimum	14,700	2,900	8,200
	(2.42)	(4.45)	(2.75)
Maximum	25,200	7,700	20,600
	(1.41)	(1.68)	(1.10)

In the Northwest Miramichi the ratio of small salmon to large salmon for the data available (1992 to 2000) approximates 3:1 whereas in the Southwest Miramichi this ratio is closer to 2:1 (Fig. 22).

The contribution of previous spawners to the returns of salmon and to the egg depositions has increased since 1986 in terms of the proportion of the large salmon returns and the absolute number. In 1998, there were more previous spawners than 2SW salmon returning to the river. The increased egg depositions since 1984 are in large part the result of higher contributions by previous spawners which have a higher fecundity per fish than 2SW maiden fish. At the present time, the abundance of previous spawners can not be predicted. Survival of kelts from the Miramichi appears to be naturally high, probably because of large numbers of holding areas in the river and the abundant food supply early in the spring (smelt for example). Survival rates of 1SW maiden salmon to returns as consecutive spawners has been increasing since 1990 with the 1996 1SW maiden spawners having the highest observed consecutive spawning survival (Chaput et al. 1998). Survival as alternate spawners was high in the late 1980's and early 1990's but declined through 1992 to 1994 (Chaput et al. 1998).

<u>Interceptions of potential spawners and previous spawners at sea</u>

Three salmon marked in the Miramichi System were recaptured at sea in 2000. Two recaptures were reported from the mackerel drift net fishery located 20-30 km NNE of Cape North Prince Edward Island. The first of these fish was recaptured on June 5 and had been tagged as a 1SW adult in the fall of 1999. The second was recaptured on June 23 and had been tagged as a smolt in the spring of 1999. The third recapture was from the Northern Peninsula coast of Newfoundland at Lance aux Meadows on September 12 and had been tagged as a 1SW adult in the fall of 1999.

Expectations for small salmon in 2001

A mark and recapture experiment to estimate the smolt production from the Northwest Miramichi was conducted in 1998 to 2000 (Chaput et al. 2001). The smolt run was underestimated in 1998 because of an incomplete sampling of the catch at the recapture trapnet. Smolt estimates for the Northwest Miramichi were the highest in 1999 at 450,000 fish and lowest in 2000 at 155,000 fish (Fig. 23). Smolt production estimates, returns of adults by age group and estimated sea survivals are summarized below:

Year	Smolt estimate	Returns of 1SW salmon in year +1	Returns of 2SW salmon in year + 2	Sea survival of 1SW salmon	Sea survival of 2SW salmon
1998	250,000[1]	11,000 (8900 – 13700)	3300 (0 – 6600)	4.5%	1.3%
1999	420,000 (340,000 – 546,000)	12,900 (10600 – 15500)		3.1% (1.9% - 4.6%)	
2000	155,000 (109,000 – 257,000)				

[1] 1998 smolt estimate from mark and recapture of 144,000 fish was an underestimate and a more realistic value of 250,000 fish was assumed

At a sea survival between 3% and 5% for 1SW salmon, small salmon returns to the Northwest Miramichi in 2001 are expected to be between 5,000 and 8,000 fish, similar to 1998 returns. There is no estimate for the Southwest Miramichi.

Hatchery Stocking

Various life stages are reared and stocked annually to the Miramichi River. Satellite rearing, initiated in 1984, augmented with some releases directly from the hatchery resulted in the stocking of more than 208 thousand fall fingerlings (Table 16; Appendix 4). The survivors of these would return three to four years later. Smolt stocking was an important component in previous years but no smolts were stocked in 2000 and less than 5000 smolts were stocked in 1999. This compares with 45,000 2+ smolts released in 1998 and 60,000 in 1997. Distribution of the life stages occurred throughout the Miramichi system with the greatest quantities of parr stocked in the Southwest Miramichi (Fig. 24; Appendix 4).

Adipose-clipped fish return mostly as small salmon and the contribution to large salmon returns were less than 0.3% in the 1997 and 0% in 1998. In 1999 and 2000, adipose-clipped large salmon represented less than 2% of the returns in both the Northwest and Southwest Miramichi (Table 17). Returns of small salmon from stocking in previous years were expected to decline from the levels observed in 1998. Adipose-clipped small salmon represented 1% or less of the year 2000 returns in the Northwest and Southwest Miramichi but were more abundant in the early returns (Table 17).

CONCLUSIONS AND MANAGEMENT CONSIDERATIONS

Was conservation met in 2000?

The point estimates of the egg contributions in the total returns were below the conservation egg requirements for the Northwest Miramichi, Southwest Miramichi and the Miramichi River system overall. This is the third consecutive year for the Northwest Miramichi and the Miramichi River and the fourth consecutive year for the Southwest Miramichi that the eggs in the total returns of Atlantic salmon were less than the conservation requirement. Given the uncertainty in the estimates of returns, there remains a chance that total eggs in the returns would have met or exceeded the conservation requirements: 41% chance for the Miramichi overall, 47% for the Southwest Miramichi and 36% for the Northwest Miramichi. Egg depositions achieved in the river would have been below conservation requirements.

What is contributing to the continued low returns of small salmon and large salmon?

The low returns of large salmon in 2000 were consistent with the low returns of small salmon in 1999. Large salmon returns are following a relatively consistent pattern of about one large salmon for every two small salmon which suggests that it is the smolt class which is being affected, i.e., the constraint is occurring within the first year. Small salmon returns to the Miramichi River have been low in the past four years (22,600 to 36,000 fish). Low small salmon abundance in the last four years corresponds to a larger size at age of 1SW salmon although large size-at-age of 1SW salmon in 1986 and 1992 corresponded to high abundance years. An association between body size and abundance requires further analysis.

Based on the estimates of smolt production from the Northwest Miramichi, low adult abundance appears to be related to both lower than expected smolt production and low sea survival. Smolt migrations of 420 thousand and 155 thousand fish for the last two years are equivalent to 2.5 and 0.9 smolts per 100 m^2 which is much less than the considered optimum production of 3 to 5 smolts per 100 m^2 (Elson 1975). This lower smolt production relative to high juvenile abundance is indicative of a freshwater constraint in the Miramichi River.

Will the returns in 2001 exceed the conservation requirements for the Miramichi River?

The trend in returns of large salmon and small salmon in recent years and the continued low abundance of small salmon in 2000 suggest that the returns of large salmon in 2001 will be less than the conservation requirement for the river. Based on the average return of small salmon in 1996 to 2000 and the returns of small salmon in 2000, there is about a 50:50 chance that egg contributions in the returns of small salmon and large salmon to the Miramichi River will meet or exceed conservation requirements but less for each branch: 39% chance for the Southwest Miramichi, 34% chance for the Northwest Miramichi, and 54% chance for the Miramichi overall.

What are the options for inseason assessments of the risk of not meeting conservation requirements?

The options for an inseason assessment for the Miramichi are limited and the inseason approach proposed by Chaput et al. (2000) has not been effective in the last three years. The approach, based on counts at the DNRE barrier fences, was qualitative and focused on whether the counts of fish at the barriers can provide an indication of the kind of year (good, fair, poor) it will be relative to what was observed in the past. The assumptions of the approach were:

- barrier fence counts are indicators of escapement rather than returns,

- run-timing over that time period is variable but generally predictable,
- objective escapement of 20000 large salmon to the Miramichi. This level of escapement should provide the conservation egg requirement for the river and in recent years based on the level of exploitation on salmon represents about 22000 large salmon returns to the river.
- objective escapement of 30000 small salmon would represent a return of about 45000 to 50000 small salmon to the Miramichi. Much higher numbers of small salmon have been observed previously although this is the level observed between 1994 and 1996.

Variations in run timing at the barriers and the proportion of the run which occurs early has changed over the six years of data collected at the Millerton trapnet in the Southwest Miramichi and in the Northwest Miramichi (Fig. 11a,b). Estimates of inseason returns could be obtained from the catches at the estuarine trapnets and assumed efficiencies based on the mark and recapture experiments of previous years (Millerton trapnet in the Southwest Miramichi; Cassilis trapnet in the Northwest Miramichi).

What are the risks to meeting conservation egg depositions in 2001 if fisheries occur?

The probability of meeting conservation requirements in 2001 was estimated from the predicted return of large salmon in 2001 based on the small:large salmon ratio of 1996 to 2000 and assuming that small salmon returns in 2001 would be similar to the previous five-year average. The model to assess the risk to conservation if fisheries were to occur in year 2001 can account for seasonal differences in harvest levels, catch-and-release mortality, and biological characteristics of the adults (Table 18). Risk is quantified in terms of the probability of meeting conservation and the egg loss resulting from the fisheries harvests as a percentage of total eggs in the returns of adult salmon to the river (Figs. 25 to 27).

For the Miramichi River overall, there is a 54% probability of meeting conservation in year 2001, in the absence of fisheries. Egg loss as a percentage of total eggs in the returns would be less than 10% if large salmon losses due to fisheries were less than 1000 fish and small salmon losses less than 9000 fish (Fig. 25).

For the Northwest Miramichi, there is a modest chance (34%) that the conservation egg requirements will be met in year 2001. With fisheries harvests at the level of previous years (6800 small salmon, 350 large salmon), greater than 20% of the total eggs in the returns would be lost and the probability of meeting conservation would decrease to less than 15% (Fig. 26).

For the Southwest Miramichi, there is a 39% chance of meeting conservation egg requirements in year 2001, in the absence of fisheries. With fisheries harvests at the level of previous years (10500 small salmon, 200 large salmon), just under 10% of the total eggs in the returns would be lost and the probability of meeting conservation would decrease to just above 30% (Fig. 27).

Recommendations for future research

The mark and recapture data from previous years should be assessed relative to an appropriate model. If the Darroch model is to be used in preference to others, then the previous years data should be reanalysed using it.

Changes in size-at-age of adults and juveniles and the possible associations with abundance and smolt production should be studied. Evidently, high juvenile abundance in the Miramichi is not resulting in the expected abundance of adults.

REFERENCES

Amiro, P.G. 1983. Aerial photographic measurement of Atlantic salmon habitat of the Miramichi River, New Brunswick. CAFSAC Res. Doc. 83/74.

Anonymous 1996. Report on the status of Atlantic salmon stocks in eastern Canada in 1995. DFO Atlantic Fisheries Stock Status Report 96/80.

Arnason, A.N., C.W. Kirby, C.J. Schwarz, and J.R. Irvine. 1996. Computer analysis of data from stratified mark-recovery experiments for estimation of salmon escapements and other populations. Can. Tech. Rep. Fish. Aquat. Sci. No. 2106.

CAFSAC. 1991. Quantification of Conservation for Atlantic Salmon. CAFSAC Adv. Doc. 91/16.

Chaput, G., R. Jones, L. Forsyth, and P. Leblanc. 1994a. Assessment of the Atlantic salmon (*Salmo salar*) stock of the Margaree River, Nova Scotia, 1993. DFO Atlantic Fisheries Res. Doc. 94/6.

Chaput, G., D. Moore, M. Biron, and R. Claytor. 1994b. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1993. DFO Atlantic Fisheries Res. Doc. 94/20.

Chaput, G., M. Biron, D. Moore, B. Dube, M. Hambrook, and B. Hooper. 1995. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1994. DFO Atlantic Fisheries Res. Doc. 95/131.

Chaput, G., M. Biron, D. Moore, B. Dube, C. Ginnish, M. Hambrook, T. Paul, and B. Scott. 1996. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1995. DFO Atlantic Fisheries Res. Doc. 96/124.

Chaput, G., D. Moore, J. Hayward, C. Ginnish, B. Dubee, and M. Hambrook. 1997. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1996. DFO Atlantic Fisheries Res. Doc. 97/20.

Chaput, G., D. Moore, J. Hayward, C. Ginnish, B. Dubee. 1998. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1997. DFO Can. Stock Assess. Secr. Res. Doc. 98/34.

Chaput, G., D. Moore, J. Hayward, J. Shaesgreen, and B. Dubee. 1999. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1998. DFO Can. Stock Assess. Secr. Res. Doc. 99/049.

Chaput, G., D. Moore, J. Hayward, J. Shaesgreen, and B. Dubee. 2000. Stock status of Atlantic salmon (*Salmo salar*) in the Miramichi River, 1999. DFO Can. Stock Assess. Secr. Res. Doc. 2000/004.

Chaput, G., P. Hardie, J. Hayward, D. Moore, J. Shaesgreen, and NSPA. 2001. Atlantic salmon smolt migrations and characteristics from the Northwest Miramichi River, 1998 to 2000. Can. Tech. Rep. Fish. Aquat. Sci. (In prep.).

Claytor, R.R., G.A. Nielsen, and P.A. Shelton. 1992. Using jackknife and Monte Carlo simulation experiments to evaluate forecast models for Atlantic salmon (*Salmo salar*). p. 203-219. *In* S.J. Smith, J.J. Hunt and D. Rivard [ed.] Risk evaluation and biological reference points for fisheries management. Can. Spec. Publ. Fish. Aquat. Sci. No. 120.

Claytor, R.R., R.G. Randall, and G.J. Chaput. 1991. Forecasting preseason and inseason Atlantic salmon returns to the Miramichi River: parametric and non-parametric approaches. CAFSAC Res. Doc. 91/15.

Courtenay, S.C., D.S. Moore, R. Pickard, and G. Nielsen. 1993. Status of Atlantic salmon in the Miramichi River in 1992. DFO Atlantic Fisheries Res. Doc. 93/56.

Elson, P.F. 1975. Atlantic salmon rivers smolt production and optimal spawning: an overview of natural production. Int. Atl. Salmon Found. Spec. Publ. Ser. 6: 96-119.

Grant, J.W.A. and D.L. Kramer. 1990. Territory size as a predictor of the upper limit to population density of juvenile salmonids in streams. Can. J. Fish. Aquat. Sci. 47: 1724-1737.

Hardie, P., R.A. Cunjak, and S. Komadina-Douthwright. 1998. Fish movement in Catamaran Brook, N.B. (1990-1996). Can. Data Rep. of Fish. Aquat. Sci. No. 1038.

Moore, D.S., G. Chaput, and R. Pickard. 1995. The effect of fisheries on the biological characteristics and survival of mature Atlantic salmon (*Salmo salar*) from the Miramichi River. *In* E.M.P. Chadwick [ed.] Water, science, and the public: the Miramichi ecosystem. Can. Spec. Publ. Fish. Aquat. Sci. No. 123.

Moore, D.S., B. Dubee, B. Hooper, and M. Biron. 1995. Angling catch and effort for the Miramichi River from 1969 to 1994. DFO Atlantic Fisheries Res. Doc. 95/4.

Moore, D.S., S.C. Courtenay, R. Claytor, and R. Pickard. 1992. Status of Atlantic salmon in the Miramichi River during 1991. CAFSAC Res. Doc. 92/38.

Moore, D.S., S. Courtenay, and P.R. Pickard. 1991. Status of Atlantic salmon in the Miramichi River during 1990. CAFSAC Res. Doc. 91/8.

Randall, R.G. 1985. Spawning potential and spawning requirements of Atlantic salmon in the Miramichi River, New Brunswick. CAFSAC Res. Doc. 85/68.

Randall, R.G. 1989. Effect of sea age on the reproductive potential of Atlantic salmon (*Salmo salar*) in eastern Canada. Can. J. Fish. Aquat. Sci. 46: 2210-2218.

Randall, R.G. and E.M.P. Chadwick. 1983a. Assessment of the Miramichi River salmon stock in 1982. CAFSAC Res. Doc. 83/21.

Randall, R.G. and E.M.P. Chadwick. 1983b. Biological assessment of Atlantic salmon in the Miramichi River, N.B., 1983. CAFSAC Res. Doc. 83/83.

Randall, R.G., E.M.P. Chadwick, and E.J. Schofield. 1985. Status of Atlantic salmon in the Miramichi River, 1984. CAFSAC Res. Doc. 85/2.

Randall, R.G., E.M.P. Chadwick, and E.J. Schofield. 1986. Status of Atlantic salmon in the Miramichi River, 1985. CAFSAC Res. Doc. 86/2.

Randall, R.G., D.M. Moore, and P.R. Pickard. 1990. Status of Atlantic salmon in the Miramichi River during 1989. CAFSAC Res. Doc. 90/4.

Randall, R.G., M.F. O'Connell, and E.M.P. Chadwick. 1989. Fish production in two large Atlantic coast rivers: Miramichi and Exploits, p. 92-308. *In* D.P. Dodge [ed.] Proceedings of the International Large River Symposium. Can. Spec. Publ. Fish. Aquat. Sci. No. 106.

Randall, R.G., P.R. Pickard, and D. Moore. 1989. Biological assessment of Atlantic salmon in the Miramichi River, 1988. CAFSAC Res. Doc. 89/73.

Randall, R.G. and E.J. Schofield. 1987. Status of Atlantic salmon in the Miramichi River, 1986. CAFSAC Res. Doc. 87/5.

Randall, R.G. and E.J. Schofield. 1988. Status of Atlantic salmon in the Miramichi River, 1987. CAFSAC Res. Doc. 88/49.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191. 391p.

Riddell, B.E. and W.C. Leggett. 1981. Evidence of an adaptive basis for geographic variation in body morphology and time of downstream migration of juvenile Atlantic salmon (*Salmo salar*). Can. J. Fish. Aquat. Sci. 38: 308-320.

Saunders, R.L. 1967. Seasonal pattern of return of Atlantic salmon in the Northwest Miramichi River, New Brunswick. J. Fish. Res. Bd. Canada 24: 21-32.

Saunders, R.L. 1981. Atlantic salmon (*Salmo salar*) stocks and management implications in the Canadian Atlantic Provinces and New England, USA. Can. J. Fish. Aquat. Sci. 38: 1612-1625.

Warren, W. G., and J. B. Dempson. 1995. Does temporal stratification improve the accuracy of mark-recapture estimates of smolt production: a case study based on the Conne River, Newfoundland. N. Am. J. Fish. Manage. 15: 126-136.

Whoriskey, F, Jr., S. Tinker, C. Connell, and L. Perley. 1999. Report on 1998 Field Work. Atlantic Salmon Federation / J.D. Irving, Limited Collaborative Research Program Little Main Restigouche and Clearwater Brook (Miramichi River System). Available from F. Whoriskey, Atlantic Salmon Federation, P.O. Box 429, St. Andrews, N.B., Canada, E0G 2X0.

Zippin, C. 1956. An evaluation of the removal method of estimating animal populations. Biometrics 12: 163-189.

Table 1. Food fishery agreements for First Nations on the Miramichi River, 1992 to 2000.

Year	Season	Tributary	Small	Large	Gear
Eel Ground First Nation					
1992	May 1-Dec 31	Northwest	1400	100	trapnet and up to 18 gillnets
1993	May 1-Dec 31	Northwest	1400	100	trapnet and up to 18 gillnets
1994	May 1-Aug 31	Southwest	1000	0	1 trapnet
	May 1-Aug 31	Northwest	1400	0	2 trapnets, up to 14 gillnets, and recreational
	May 1 to Dec 31	Northwest	0	100	up to 14 gillnets
1995	May 1- Aug 31	Southwest	1420	0	1 trapnet and recreational
	Sept 1- Oct 31	Southwest	800	0	1 trapnet and recreational
	May 1- Aug 31	Northwest	1980	100	2 trapnets, up to 10 gillnets, and recreational
	Sept 1- Oct 31	Northwest	800	0	2 trapnets, up to 10 gillnets, and recreational
1996	May 1- Aug 31	Southwest	1320	0	2 trapnets and recreational
	Sept 1- Oct 31	Southwest	780	0	2 trapnets and recreational
	May 1- Aug 31	Northwest	1880	195	2 trapnets, up to 12 gillnets, and recreational
	Sept 1- Oct 31	Northwest	780	0	2 trapnets, up to 12 gillnets, and recreational
	April 15- July 31	Northwest	200	5	counting fence
	Aug 1- Oct 31	Northwest	40	0	counting fence
1997	May 1- Aug 31	Southwest	1320	0	2 trapnets and recreational
	July 22 - Aug 31	Southwest			1 gillnet
	Sept 1- Oct 31	Southwest	780	0	2 trapnets and recreational
	May 1- Aug 31	Northwest	1880	195	2 trapnets, up to 11 gillnets, and recreational
	Sept 1- Oct 31	Northwest	780		2 trapnets, up to 11 gillnets, and recreational
	April 15- July 31	Northwest	200	5	counting fence
	Aug 1- Oct 31	Northwest	40		counting fence
1998	May 1- Aug 31	Southwest	1320	0	2 trapnets, 1 gillnet, and recreational
	Sept 1- Oct 31	Southwest	780	0	2 trapnets and recreational
	May 1 - Oct 31	Both SW and NW		190	gillnets and native recreational fishing
	May 1- Aug 31	Northwest	1880	0	2 trapnets, up to 11 gillnets, and recreational
	Sept 1- Oct 31	Northwest	780	0	2 trapnets, up to 11 gillnets, and recreational
	April 15- July 31	Northwest	200	5	counting fence
	Aug 1- Oct 31	Northwest	40	0	counting fence
1999	May 25- Aug 31	Southwest	1320	0	2 trapnets, 1 gillnet, and recreational
	Sept 1- Oct 31	Southwest	780	0	2 trapnets and recreational
	May 25 - Oct 31	Both SW and NW		195	gillnets and native recreational fishing
	May 25- Aug 31	Northwest	1880	0	2 trapnets, up to 11 gillnets, and recreational
	Sept 1- Oct 31	Northwest	780	0	2 trapnets, up to 11 gillnets, and recreational
	May 25- July 31	Northwest	200	5	counting fence
	Aug 1- Oct 31	Northwest	40	0	counting fence
2000	May 25- Aug 31	Southwest	1320	0	2 trapnets, 1 gillnet, and recreational
	Sept 1- Oct 31	Southwest	780	0	2 trapnets and recreational
	May 25 - Oct 31	Both SW and NW		195	gillnets and native recreational fishing
	May 25- Aug 31	Northwest	1880	0	2 trapnets, up to 11 gillnets, and recreational
	Sept 1- Oct 31	Northwest	780	0	2 trapnets, up to 11 gillnets, and recreational
	May 25- July 31	Northwest	200	5	counting fence
	Aug 1- Oct 31	Northwest	40	0	counting fence

Table 1 (continued). Food fishery agreements for First Nations on the Miramichi River, 1992 to 2000.

Year	Season	Tributary	Small	Large	Gear
Red Bank First Nation					
1992	May 1 - Dec 30	NW and LSW	5000	10	2 trapnets and recreational
1993	May 1 - Dec 31	NW and LSW	5000	10	2 trapnets and recreational
1994	June 1- Aug 31	Little Southwest	1000	5	1 trapnet and recreational
	Sept 1- Oct 31	Little Southwest	1000	5	1 trapnet and recreational
	June 1- Aug 31	Northwest	1000	5	1 trapnet and recreational
	Sept 1- Oct 31	Northwest	1000	5	1 trapnet and recreational
1995	June 1- Aug 31	Little Southwest	1320	60	1 trapnet and recreational
	Sept 1- Oct 31	Little Southwest	680	10	1 trapnet and recreational
	June 1- Aug 31	Northwest	1320	60	1 trapnet and recreational
	Sept 1- Oct 31	Northwest	680	10	1 trapnet and recreational
1996	June 1- Aug 31	Little Southwest	1320	71	1 trapnet and recreational
	Sept 1- Oct 31	Little Southwest	680	141	1 trapnet and recreational
	June 1- Aug 31	Northwest	1320	70	1 trapnet and recreational
	Sept 1- Oct 31	Northwest	680	141	1 trapnet and recreational
1997	June 1- Aug 31	Little Southwest	1320	100	1 trapnet, 2 gillnets, and recreational
	Sept 1- Oct 31	Little Southwest	680	100	1 trapnet, 2 gillnets, and recreational
	June 1- Aug 31	Northwest	1320	150	1 trapnet, 4 gillnets, and recreational
	Sept 1- Oct 31	Northwest	680	150	1 trapnet, 4 gillnets, and recreational
1998	June 1- Aug 31	Little Southwest	1320	100	1 trapnet, 2 gillnets (June 8 -17 only), and angling
	Sept 1- Oct 31	Little Southwest	680	100	1 trapnet, 2 gillnets, and recreational
	June 1- Aug 31	Northwest	1320	150	1 trapnet, 2 gillnets (June 8-17 only), and angling
	Sept 1- Oct 31	Northwest	680	150	1 trapnet, 2 gillnets, and angling
1999	May 25- Aug 31	Northwest	2640	250	1 trapnet, 2 gillnets (May 25-17 only), and angling
	Sept 1- Oct 31	Northwest	1360	250	1 trapnet, 2 gillnets, and recreational
	May 25-June 17	Little Southwest			1 gillnet and recreational (included in allocation from Northwest)
2000	May 25- Aug 31	Northwest	2640	250	1 trapnet, 2 gillnets (May 25-17 only), and angling
	Sept 1- Oct 31	Northwest	1360	250	1 trapnet, 2 gillnets, and recreational
	May 25-June 17	Little Southwest			1 gillnet and recreational (included in allocation from Northwest)
Burnt Church First Nation					
1992	May 1- Dec 31	Miramichi Bay	2000	25	up to 25 gillnets plus angling
1993	May 1- Dec 31	Miramichi Bay	2000	25	up to 25 gillnets plus angling
1994	May 1- Dec 31	Miramichi Bay	2000	25	up to 25 gillnets plus angling
1995	May 1- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling
1996	May 1- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling
1997	May 1- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling
1998	April 15- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling
1999	May 1- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling
2000	May 1- July 31	Miramichi Bay	1300	80	up to 25 gillnets plus angling
	Aug 1- Oct 15	Miramichi Bay	700	120	up to 25 gillnets plus angling

Table 2. Bright salmon angling seasons and quotas for 2000.

General Season: April 15 - October 31
General Daily Quota: Retain 1 grilse Release 4 fish (fishing must cease after 1 grilse is retained)

Exceptions to General Season:

Opens April 15; Closes August 31
- NW Miramichi River upstream from Little River
- Rocky Brook, tributary of SW Miramichi River

Opens April 15; Closes September 15
- All tributaries of SW Miramichi River upstream of the Cains River except Rocky Brook
- Big Sevogle River upstream from Square Forks
- Dungarvon River upstream of the Furlong Bridge
- LSW Miramichi River upstream of Catamaran Brook
- SW Miramichi above the forks at Juniper, including the North and South Branches of the SW Miramichi River
- North and South Branches of the Renous River

Opens April 15; Closes September 30:
- SW Miramichi River upstream of the mouth of Burnt Land Bk. to the forks at Juniper and Clearwater Brook

Opens April 15; Closes October 15:
- Bartholomew River
- Big Sevogle River, downstream from Square Forks
- Cains River
- Dungarvon River, downstream from the Furlong Bridge
- LSW Miramichi River downstream from Catamaran Bk.
- NW Miramichi River, downstream from Little River
- Renous River, downstream from the confluence of the North and South Branches
- Southwest Miramichi River downstream from Burntland Bk.
- Southwest Miramichi River tributaries downstream of the Cains River which are not mentioned above

Hook and Release Only Angling (salmon angling licence)

Opens October 1; Closes October 15:
- Southwest Miramichi River upstream from Burntland Bk. to the forks at Juniper

Opens September 16; Closes October 15:
- Little Southwest Miramichi River upstream from Catamaran Bk. to and including Cleland's Pool

Opens September 1; Closes September 15:
- Northwest Miramichi River upstream from Little River to a point 200m upstream of the forks of the North and South Branches of the Northwest Miramichi River

Hook and Release Only Angling (with a Hook and Release Licence)

Opens July 1; Closes September 15:
- North Pole Stream from its mouth upstream to Lizard Bk.
- Little Southwest Miramichi River, from and including Big Rock Pool upstream to include the east and west branches, not including tributaries or lakes

Opens June 1; Closes September 15:
- Lower North Branch of the LSW Miramichi River, from and including Rocky Rapids Pool upstream to its source including all tributaries
- Cains River, from the river ford located approximately 3/4 km upstream from Hopewell Lodge to and including Lower Otter Brook Pool exclusive of all tributaries

Variation order affecting bright salmon angling seasons and quotas for 2000

GULF FISHERIES MANAGEMENT REGION CLOSE TIME AND QUOTA VARIATION ORDER, 2000-143
Dated at Moncton, New Brunswick, August 30, 2000.

Southwest Miramichi River upstream from the mouth of Burnt Land Brook to the fork of North and South Branch at Juniper and Clearwater Brook: Open season April 15 to September 30.

From September 16 to September 30, hook and release will be permitted up to 4 salmon in the waters of the Clearwater Brook upstream to the fork of the Northeast Branch Clearwater. Fishers are not permitted to retain any salmon.

Table 3. Harvest and effort (net days) for aboriginal food fisheries on the Miramichi River in 2000 by early and late runs. Harvests are reported by band councils.

	Burnt Church Gillnets		Eel Ground Gillnets			Eel Ground SW Trapnet	Eel Ground NW Trapnet	Eel Ground NW Big Hole Fence		Red Bank Trapnets	
	Small	Large	Effort	Small	Large	Small	Small	Small	Large	Small	Large
Early Run											
May 21- May 27	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0
May 28 - June 3	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0
June 4 - 10	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	12	23
June 11 - 17	n.a.	n.a.	n.a.	n.a.	n.a.	6	5	23	0	57	24
June 18- 24	n.a.	n.a.	n.a.	n.a.	n.a.	8	11	6	0	104	24
June 25 - July 1	n.a.	n.a.	n.a.	n.a.	n.a.	58	37	43	0	206	29
July 2 - 8	n.a.	n.a.	n.a.	n.a.	n.a.	47	16	98	5	257	42
July 9 - 15	n.a.	n.a.	n.a.	n.a.	n.a.	95	56	33	0	325	28
July 16 - 22	n.a.	n.a.	n.a.	n.a.	n.a.	75	72	0	0	56	2
July 23 - 29	n.a.	n.a.	n.a.	n.a.	n.a.	44	44	0	0	74	0
July 30 - Aug 5	n.a.	n.a.	n.a.	n.a.	n.a.	47	14	0	0	188	0
Aug 6 - 12	n.a.	n.a.	n.a.	n.a.	n.a.	29	12	0	0	135	4
Aug 13 - 19	n.a.	n.a.	n.a.	n.a.	n.a.	21	0	0	0	111	2
Aug 20 - 26	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	125	1
Aug 27 - 31	n.a.	n.a.	n.a.	n.a.	n.a.	21	0	0	0	95	3
Subtotal	n.a.	n.a.	n.a.	n.a.	n.a.	451	267	203	5	1745	182
Late Run	n.a.	n.a.	n.a.	n.a.	n.a.						
Sept 1 - 2	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	14	8
Sept 3 - 9	n.a.	n.a.	n.a.	n.a.	n.a.	0	2	0	0	45	14
Sept 10 - 16	n.a.	n.a.	n.a.	n.a.	n.a.	0	9	0	0	86	24
Sept 17 - 23	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	76	17
Sept 24 - 30	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	40	23
Oct 1 - 7	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	15	6
Oct 8 - 14	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0
Oct 15 - 21	n.a.	n.a.	n.a.	n.a.	n.a.	0	0	0	0	0	0
Subtotal	n.a.	n.a.	n.a.	n.a.	n.a.	0	11	0	0	276	92
Total season	n.a.	n.a.	n.a.	n.a.	n.a.	451	278	203	5	2021	274
Early Run	n.a.	n.a.	n.a.	n.a.	n.a.	100%	96%	100%	100%	86%	66%

Table 4. Summary of broodstock collections in 2000.

Stock Collected	Date Collected	Female		Male		Collection Site
		Large	Small	Large	Small	
Northwest Miramichi						
Little Southwest	Sept. 8	6	0	2	8	Moose Landing, seined
Northwest	Sept. 26	10	0	4	6	NW Barrier Pool, seined
Sevogle	Sept.	5	0	0	2	Square Forks Pool, angled
Subtotal		**21**	**0**	**6**	**16**	
Southwest Miramichi						
SW Miramichi (upper)	Sept. 27	0	0	0	5	Juniper Bridge – seined
	Oct. 5	10	0	3	1	Juniper Bridge – seined
SW Miramichi (middle)	Sept. 19 – Oct. 9	21	0	2	18	Doaktown to Boistown area, angled
SW Miramichi (lower)	Sept. 18 – Oct. 8	16	0	3	10	Quarryville to Upper Blackville area, angled
Burnthill	July 5 - 25	8	0	0	10	Burnthill counting fence
Clearwater	July 9	11	1	0	9	Irving Counting Fence
Rocky Brook	Sept.	3	0	2	3	Cold Spring – seined
	Oct.	2	0	0	0	Hurd Spring – seined
Cains	Sept.	1	0	0	0	Island pool – angled
Dungarvon	Sept. 20	2	1	2	1	Furlong Bridge – seined
Subtotal		**74**	**2**	**12**	**57**	
Total		**95**	**2**	**18**	**73**	

Table 5. Removals of Atlantic salmon by size and season from the Northwest Miramichi, Southwest Miramichi and total Miramichi River system in 2000. No angling removal estimates are available to date.

	Northwest Miramichi			Southwest Miramichi			Miramichi River		
	Early	Late	Total	Early	Late	Total	Early	Late	Total
Small salmon									
Food fisheries[1]	?	?	?	0	0	0	?	?	?
Food fisheries[2]	2215	287	2502	451	0	451	2666	287	2953
Angling	?	?	?	?	?	?	?	?	?
Seizures	29	0	29	0	0	0	29	0	29
Broodstock	16	0	16	29	30	59	45	30	75
Incidental mortalities	20	0	20	4	2	6	24	2	26
Furunculosis[3]	1	0	1	0	0	0	1	0	1
Vibrio[4]	0	0	0	0	0	0	0	0	0
Total	2281	287	2568	484	32	516	2765	319	3084
Large salmon									
Food fisheries[1]	?	?	?	0	0	0	?	?	?
Food fisheries[2]	187	92	279	0	0	0	187	92	279
Angling	?	?	?	?	?	?	?	?	?
Seizures	0	0	0	1	0	1	1	0	1
Broodstock	27	0	27	40	46	86	67	46	113
Incidental mortalities	9	0	9	18	1	19	27	1	28
Furunculosis[3]	4	0	4	2	0	2	1	0	6
Vibrio[4]	0	0	0	0	0	0	0	0	0
Total	227	92	319	61	47	108	283	139	427

Notes: [1]Gillnet fisheries

[2]Fence and trapnet fisheries

[3]Furunculosis mortalities only include cases confirmed by the DFO Fish Health Unit (of fish tested in 2000).
All confirmed cases occurred between June 7 and July 11and their locations were:

NW Miramichi	one grilse at Red Bank
	two salmon at Red Bank / Sunny Corner
	one salmon at the Northwest DNRE barrier
	one salmon in the North Branch of the Sevogle River
SW Miramichi	one salmon in Doaktown
	one salmon at Don Bamford Pool (MSW Miramichi)

[4]Vibrio mortalities only include cases confirmed by the DFO Fish Health Unit (of fish tested in 2000).

Table 6. Summary of trapnet operation dates, catch, and tags applied in the Miramichi River, 2000. Catch represents all fish sampled, including recaptures.

Trapnets	Time Period	Catch		Tagged	
		Small	Large	Small	Large
NW Miramichi					
Eel Ground Lower	June 3 to Sept. 22	363	103	70	73
Red Bank NW	June 5 to Oct. 5	954	240	0	0
Red Bank LSW	June 5 to Oct. 5	1247	399	0	0
Cassilis	June 19 to Oct. 15	1211	314	1075	270
SW Miramichi					
Eel Ground Lower	May 30 to Sept. 28	697	164	643	124
Eel Ground Upper	June 2 to Sept. 29	973	272	420	224
Millerton	May 26 to Oct. 20	1589	431	1436	374

Table 7. Mark and recapture matrices used in the estimation of returns of small salmon and large salmon to the Miramichi River and each branch in 2000.

Small salmon			To recapture trapnets			
		Tags	NW		SW	
From		Placed	Early	Late	Early	Late
NW	Early	795	117	15	2	3
	Late	345	0	15	0	7
SW	Early	682	20	7	25	4
	Late	383	0	1	0	26
Catch			1757	436	946	559

Small salmon			
	Tags	To	
From	Placed	NW	SW
NW	1140	147	12
SW	1065	28	55
Catch		2193	1505

Large salmon			To recapture trapnets			
		Tags	NW		SW	
From		placed	Early	Late	Early	Late
NW	Early	198	15	4	1	3
	Late	152	0	3	0	1
SW	Early	227	4	1	3	2
	Late	128	0	0	0	4
Catch			473	167	201	201

Large salmon			
	Tags	To	
From	Placed	NW	SW
NW	350	22	5
SW	355	5	9
Catch		640	402

Table 8. Estimated returns, removals (partial, exclusive of angling removals), and escapements (unaccounting for angling removals) of small salmon and large salmon to the Northwest Miramichi, Southwest Miramichi and Miramichi River in 2000.

		Returns to recapture trapnets	Harvest below recapture trapnets[1]	Total returns	Total removals	Escapement
Northwest Miramichi						
Small	Median	12,600	300	12,900		
	5th	10,300		10,600		
	95th	15,200		15,500		
Large	Median	4,500	195	4,700		
	5th	0		0		
	95th	9,200		9,400		
Southwest Miramichi						
Small	Median	22,100	451	22,600		
	5th	16,800		17,200		
	95th	28,500		28,900		
Large	Median	13,100	0	13,100		
	5th	7,400		7,400		
	95th	31,000		31,000		
Miramichi River						
Small	Median	35,000	750	36,000		
	5th	30,000		31,000		
	95th	42,000		43,000		
Large	Median	18,000	200	18,200		
	5th	13,000		13,300		
	95th	29,000		29,300		

[1]Harvest below recapture trapnets are preliminary and assume the aboriginal fisheries allowance of large salmon using gillnets (195 salmon) from the Northwest Miramichi was caught.

Table 9. Biological characteristics (fork length, sex ratio, and fecundity[1]) of small salmon and large salmon for the Southwest and Northwest Miramichi and Miramichi River system for 2000.

		Small salmon		Large salmon	
		Estimate	Std. Dev.	Estimate	Std. Dev.
Northwest Miramichi					
% Female	early	28.1		72.0	
	late	9.0		69.3	
	total	21.9		70.6	
Fork length	early	55.1	2.90	80.1	9.35
(cm)	late	58.2	2.59	75.9	8.69
	total	56.0	3.15	77.9	9.24
Fecundity[1]	early	976		5552	
	late	372		4952	
	total	801		5234	
% Previous[2]	early			39.7	
Spawners	late			21.4	
	total			29.9	
Southwest Miramichi					
% Female	early	18.4		79.5	
	late	11.7		68.1	
	total	15.8		73.4	
Fork length	early	55.5	2.85	80.5	8.99
(cm)	late	58.0	2.72	76.5	9.41
	total	56.4	3.05	78.4	9.42
Fecundity[1]	early	654		6174	
	late	478		4921	
	total	591		5491	
% Previous	early			41.0	
Spawners	late			25.4	
	total			32.8	
Miramichi River					
% Female	early				
	late				
	total	18.0		72.7	
Fork length	early				
(cm)	late				
	total	56.3		78.3	
Fecundity[1]	early				
	late				
	total	669		5429	
% Previous	early				
Spawners	late				
	total			32.0	

[1] Fecundity (eggs per fish) calculated using fecundity-length relationship (Randall 1989) and sex ratios.

Fecundity (small salmon) = % female * exp(3.1718*Ln(fork length) - 4.5636)

Fecundity (large salmon) = % female * exp(1.4132*Ln(fork length) + 2.7560)

[2] Combined data from Red Bank and Cassilis Trapnets

Table 10. Eggs (millions of eggs) in the total returns of small salmon, large salmon and both size groups combined in the Northwest Miramichi, Southwest Miramichi and Miramichi River system in 2000. The % of conservation requirement refers to the eggs in the returns (before any removals).

	Small	Large	Total	Contribution by large	% of conservation requirement
Northwest Miramichi					
Total	10.4	24.6	35.0	70%	
Conservation requirement			40.3	61%	87%
Southwest Miramichi					
Total	13.64	72.0	85.6	84%	
Conservation requirement			88	82%	97%
Miramichi River					
Total	24.1	97.7	121.8	80%	
Conservation requirement			129	76%	95%

Table 11. Estimated returns and escapement to the Miramichi River (to Millbank 1971 to 1991; to confluence of Northwest and Southwest branches 1992 to 2000) of small and large salmon. % change is 2000 minus mean relative to the mean. Return estimates for 1999 are revised from previous assessment (Chaput et al. 2000).

	Small Salmon				Large Salmon			
		90% Confidence Interval				90% Confidence Interval		
Year	Return	Lower	Upper	Escapement	Return	Lower	Upper	Escapement
1971	35,673			21,946	24,407			4,347
1972	46,275			27,135	29,049			17,671
1973	44,545			30,668	27,192			20,349
1974	73,418			55,186	42,592			34,445
1975	64,902			48,469	28,817			21,448
1976	91,580			62,380	22,801			14,332
1977	27,743			13,247	51,842			32,917
1978	24,287			14,353	24,493			10,829
1979	50,965			30,848	9,054			4,541
1980	41,588			26,894	36,318			18,873
1981	65,273			39,929	16,182			4,608
1982	80,379			56,000	30,758			13,258
1983	25,184			14,849	27,924			8,458
1984	29,707			18,929	15,137			14,687
1985	60,800			41,815	20,738			20,122
1986	117,549			89,398	31,285			30,216
1987	84,816			62,777	19,421			18,056
1988	121,919			90,278	21,745			20,980
1989	75,231			48,385	17,211			15,540
1990	83,500	68,000	113,100	59,524	28,574	21350	35583	27,588
1991	60,900	45,700	76,000	48,269	29,949	22400	37333	29,089
1992	152,600	128,000	184,000	129,288	37,000	31,056	44,643	35,927
1993	95,000	61,500	153,800	76,416	35,000	19,732	76,695	34,702
1994	57,000	40,500	83,000	42,479	27,544	18,278	47,023	27,147
1995	54,000	17,800	75,600	33,347	32,627	19,703	50,304	32,093
1996	44,400	36,000	65,000	24,180	24,812	17,341	32,455	23,478
1997	22,600	17,800	30,200	12,980	18,381	13,952	25,014	17,606
1998	33,000	27,500	41,000		9,500	7,500	12,500	
1999	25,700	21,000	32,100		16,200	11,900	26,900	
2000	35,600	31,000	42,100		18,200	13,300	29,300	
%change in 2000 relative to								
1999	39%				12%			
1995 to 1999	-28%				-20%			
1984 to 1999	-63%				-33%			
1971 to 1983	-50%				-43%			
Means								
1995 to 1999	35,940				20,304			
1984 to 1999	69,920				24,070			
1971 to 1983	51,678				28,571			

Table 12. Estimated returns of small and large salmon to the Southwest Miramichi and the Northwest Miramichi, 1992 to 2000. Returns for 1999 are revised estimates.

	Small salmon		Large salmon	
	Median	5th to 95th Percentile	Median	5th to 95th Percentile
Southwest Miramichi				
1992	120,700	85,300 to 157,800	25,000	17,7007 to 32,700
1993	42,600	22,700 to 73,800	21,900	10,800 to 58,900
1994	33,800	23,500 to 54,200	14,000	9,100 to 22,900
1995	31,700	10,400 to 45,300	17,100	5,700 to 24,200
1996	30,200	20,200 to 44,900	15,700	9,500 to 27,200
1997	13,500	10,400 to 18,700	11,000	8,500 to 14,600
1998	24,000	19,000 to 32,000	7,000	6,000 to 9,500
1999	14,400	10,600 to 21,100	11,500	6,500 to 24,300
2000	22,600	17,200 to 28,900	13,100	7,400 to 31,000
Northwest Miramichi				
1992	30,300	23,000 to 40,900	10,000	-
1993	46,200	27,700 to 97,500	10,500	3,700 to 37,500
1994	20,600	11,700 to 38,500	12,600	6,500 to 31,300
1995	22,400	7,100 to 32,600	15,200	7,800 to 31,500
1996	18,900	13,300 to 28,000	7,900	4,800 to 13,300
1997	9,800	6,500 to 17,300	7,000	4,400 to 13,100
1998	7,900	6,200 to 10,700	2,200	2,100 to 3,100
1999	11,000	8,600 to 14,100	4,700	1,100 to 7,500
2000	12,900	10,600 to 15,500	4,700	0 to 9,400

Table 13. Number of large salmon and small salmon counted at barriers in three tributaries of the Miramichi River, 1981 to 2000.

Tributary	Year	Large	Small	Total	Dates Operated	No. of Days
North Branch of SW Miramichi River						
	1981	54	671	725	Jul. 5-Oct. 4	92
	1982	282	621	903	Jun. 30-Oct. 8	101
	1983	219	290	509	Jul. 4-Oct. 10	99
	1984	297	230	527	Jul. 10-Oct. 16	99
	1985	604	492	1096	Jul. 1-Oct. 20	112
	1986	1138	2072	3210	Jun. 30-Oct. 19	110
	1987	1266	1175	2441	Jul. 2-Oct. 19	110
	1988	929	1092	2021	Jun. 30-Oct. 24	117
	1989	731	969	1700	Jul. 1-Oct. 24	116
	1990	994	1646	2640	Jun. 29-Oct. 14	108
	1991	476	495	971	Jun. 30-Oct. 21	107
	1992	1047	1383	2430	Jun. 30-Oct. 20	113
	1993	1145	1349	2494	Jun. 30-Oct. 22	115
	1994	905	1195	2100	June 29-Oct. 30	124
	1995	1019	811	1830	June 15-Oct. 28	136
	1996	819	1388	2207	June 20-Oct. 27	130
	1997	519	566	1085	June 23-Oct. 29	131
	1998	698	981	1679	June 1- Oct. 25	147
	1999	698	566	1264	July 1- Oct. 12	134
	2000	725	1202	1927	June 20-Oct. 27	129
1995-99	Mean	751	862	1613		136
Change (2000-mean)/mean		-3%	39%	19%		-5%
Dungarvon River						
	1981	112	550	662	Jun. 24-Oct. 8	107
	1982	122	483	605	Jun. 28-Oct. 15	110
	1983	126	330	456	Jun. 28-Oct. 14	109
	1984	93	315	408	Jul. 5-Oct. 12	100
	1985	162	536	698	Jun. 25-Oct. 10	108
	1986	174	501	675	Jun. 25-Oct. 21	119
	1987	202	744	946	Jun. 25-Oct. 14	112
	1988	277	851	1128	Jun. 2-Oct. 25	151
	1989	315	579	894	Jun. 1-Oct. 10	132
	1990	318	562	880	Jun. 1-Oct. 11	133
	1991	204	296	500	Jun. 4-Oct. 14	133
	1992	232	825	1057	Jun. 4-Oct. 16	135
	1993	223	659	882	Jun. 14-Oct. 27	131
	1994	155	358	511	June 7-Oct. 20	136
	1995	95	329	424	May 31-Oct. 13	136
	1996	184	590	804	June 4-Oct. 24	143
	1997	115	391	506	June 10-Oct. 30	155
	1998	163	592	755	June 2-Oct. 29	140
	1999	185	378	563	June 3-Oct. 14	126
	2000	130	372	502	June 21-Nov 2	134
1995-99	Mean	148	456	610		140
Change (2000-mean)/mean		-12%	-18%	-8%		-4%
Northwest Miramichi River						
	1988	234	1614	1848	Jun. 27-Oct. 26	122
	1989	287	966	1253	May 30-Oct. 12	136
	1990	331	1318	1649	May 29-Oct. 18	143
	1991	224	765	989	Jun. 4-Oct. 18	137
	1992	219	1165	1384	Jun. 3-Oct. 16	136
	1993	216	1034	1250	Jun. 14-Oct. 27	136
	1994	228	673	901	June 5-Oct. 14	132
	1995	252	548	800	June 1-Oct. 12	134
	1996	218	602	820	June 3-Oct. 24	144
	1997	152	501	653	June 3-Oct. 29	149
	1998	289	1038	1327	June 2-Oct. 28	149
	1999	387	708	1095	June 1-Oct. 19	141
	2000	217	456	673	June 22-Oct 29	129
1995-99	Mean	260	679	939		143
Change (2000-mean)/mean		-16%	-33%	-28%		-10%

Table 14. Counts of small salmon and large salmon at the Clearwater Brook and Burnthill Brook counting fences, 1997 to 2000. Data are courtesy of Chris Connell, J.D.Irving Ltd. and Fred Whoriskey, Atlantic Salmon Federation.

Year	Small	Large	Total	Operating dates	No. of days
Clearwater Brook counting fence					
1996[1]	62	16	78		
1997	365	313	678	June 10 to Oct. 24	136
1998[2]	508	208	716	May 21 to Oct. 25	158
1999	486	410	896	June 4 to Oct. 21	140
2000	518	197	715	June 2 to Nov. 3	155
Burnthill Brook counting fence					
2000	648	475	1123	June 8 to Oct. 29	144

[1] Fence counts in 1996 are low due to fence location and operating dates
[2] High water levels on Aug. 12 and Oct. 2-3 may have permitted salmon to bypass the fence

Table 15. Counts of salmon of various life stages migrating upstream and downstream at Catamaran Brook, Little Southwest Miramichi River, 1990 to 2000. Data courtesy of P. Hardie (DFO – Science Branch , Moncton, N.B.) and R. Cunjak (University of New Brunswick, Fredericton, N.B.).

	Downstream		Upstream					Smolt Survival (%) to		
	Migrant		By Size		By Age			1SW	2SW	Total
Year	Parr	Smolts	Small	Large	1SW	2SW	PS[1]	Salmon	Salmon	Salmon
1990	1269	1086	166	56	166	32	24	8.1	4.1	12.2
1991	2446	1664	88	53	88	28	25	8.5	2.0	10.5
1992	1396	2483	141	74	141	44	30	4.6	0.9	5.4
1993	1400	533	113	46	113	34	12	10.5	13.3	23.8
1994	2523	1020	56	24	56	21	3	12.8	3.3	16.2
1995	2175	1166	131	80	131	71	9	6.9	1.0	7.9
1996	602	569	80	43	80	34	9	7.2	3.2	10.4
1997	2495	1019	41	28	46	12	16	8.6	2.8	11.4
1998	958	393	88	44	88	18	26	19.1	2.5	21.6
1999	1890	222	75	41	75	28	13	24.3		
2000	788	813	56	11	54	10	3			
							median	8.6	2.8	11.4

Note: Numbers at age for 1999 and 2000 are estimated from average age composition of large and small salmon for 1994-98. Fish counts are adjusted for counting fence efficiency.

[1] PS refers to previous spawners

Table 16. Distribution of salmon juveniles in the Miramichi River in 2000. AC = adipose-clip, NM = unmarked. Preliminary numbers, distributions included to Nov. 27, 2000.

River	Life stage	Mark	Number of fish stocked	Absolute difference from 1999 (%)
Northwest Miramichi	2+ smolts	AC	0	-4,723
	1+ parr (May)	AC	0	-7,330
	0+ parr (June - Aug.)	NM	16,470	+6,970 (+73%)
	0+ parr (Sept.-Nov.)	AC	38,966	+18,678 (+92%)
Southwest Miramichi	2+ smolts	AC	0	0
	0+ parr (June - Aug)	NM	0	-12,030
	0+ parr (Sept.-Nov.)	AC	168,627	+34,835 (+26%)
	0+ parr (Sept.-Nov.)	NM	4,500	+500 (+13%)
Miramichi (total)	2+ smolts	AC	0	-4,723
	1+ parr (May)	AC	0	-7,330
	0+ parr (June - Aug.)	NM	16,470	-5060 (-23%)
	0+ parr (Sept.-Nov.)	AC	207,593	+53,513 (+35%)
	0+ parr (Sept.-Nov.))	NM	4,500	+500 (+13%)

Table 17. Relative contribution of wild and adipose-clipped salmon to returns in 2000.

	Small salmon			Large salmon		
	Wild	Adipose-clip	% wild	Wild	Adipose-clip	% wild
Southwest Miramichi (received 40,000 smolts in 1998 and 0 smolts in 1999.)						
Sampling at Millerton trapnet						
June to Aug.	958	7	99.3%	194	0	100.0%
Sept. to Oct.	614	3	99.5%	226	0	100.0%
Total	1572	10	99.4%	420	0	100.0%
Dungarvon River (received 0 smolts in 1998 and 0 smolts in 1999.)						
Seining at Furlong Bridge						
Sept. 20	82	0	100.0%	11	0	0.0%
Rocky Brook (received satellite-reared fall fingerlings annually since 1984)						
Seining at Cold Spring pool						
Sept. 19	33	1	97.1%	11	4	73.3%
Seining at Hurd pool						
Sept. 19	12	0	100.0%	2	0	100.0%
Southwest Miramichi River, headwaters (received satellite-reared fall fingerlings annually since 1997)						
Seining at Juniper Bridge						
Oct. 5	43	2	95.6%	13	0	100.0%
Northwest Miramichi (received 5,100 smolts in 1998 and 4,723 in 1999.)						
Seining at NW Barrier Pool						
Sept. 26	82	1	98.8%	22	0	100.0%
Sampling at Red Bank trapnets						
June to Aug.	1650	14	99.2%	347	5	98.6%
Sept. to Oct.	284	2	99.3%	96	0	100.0%
Total	1934	16	99.2%	443	5	98.9%
Sampling at Cassilis trapnet						
June to Aug.	798	8	99.0%	144	0	100.0%
Sept. to Oct.	389	3	99.2%	166	0	100.0%
Total	1187	11	99.1%	310	0	100.0%

Table 18. Model parameters and assumptions for evaluating the probability of meeting conservation in year 2001 and the egg loss resulting from fisheries.

Assumptions of the fisheries risk analysis model		Southwest Miramichi		Northwest Miramichi		Miramichi River	
		Salmon	Grilse	Salmon	Grilse	Salmon	Grilse
Proportion of angling catch occurring early							
Based on FISHSYS results (1984 to 1994)		60.0%	64.0%	80.0%	86.0%		
Assumed exploitation rates in angling fishery		30.0%	30.0%	30.0%	30.0%	30.0%	30.0%
Hook and release mortality estimates							
By season	Early	5.0%	5.0%	5.0%	5.0%	5.0%	5.0%
	Late	1.0%	1.0%	1.0%	1.0%	1.0%	1.0%
Season weighted		3.4%	3.6%	4.2%	4.4%		
Integrated value used in assessments		3.0%	3.0%	3.0%	3.0%	3.0%	3.0%
Fecundity of fish by season (average 1996 to 2000)							
	Early	6452	682	6,388	1,095		
	Late	5386	484	5,343	457		
	Integrated	5835	562	5912	879	5429	669
First Nations Harvests (maximum harvests achieved 1994 to 1998)							
	Early	0	1148	358	2447		
	Late	0	209	190	583		
Ratios (small / large) (1996 to 2000)							
	Min.	1.10		1.68		1.39	
	Max.	2.75		4.45		2.42	
	Median	2.02		2.70		2.18	
Small salmon returns (1996 to 2000)							
	Mean		20,940		12,100		32,000
	Std. Dev.		7,000		4,214		8,676

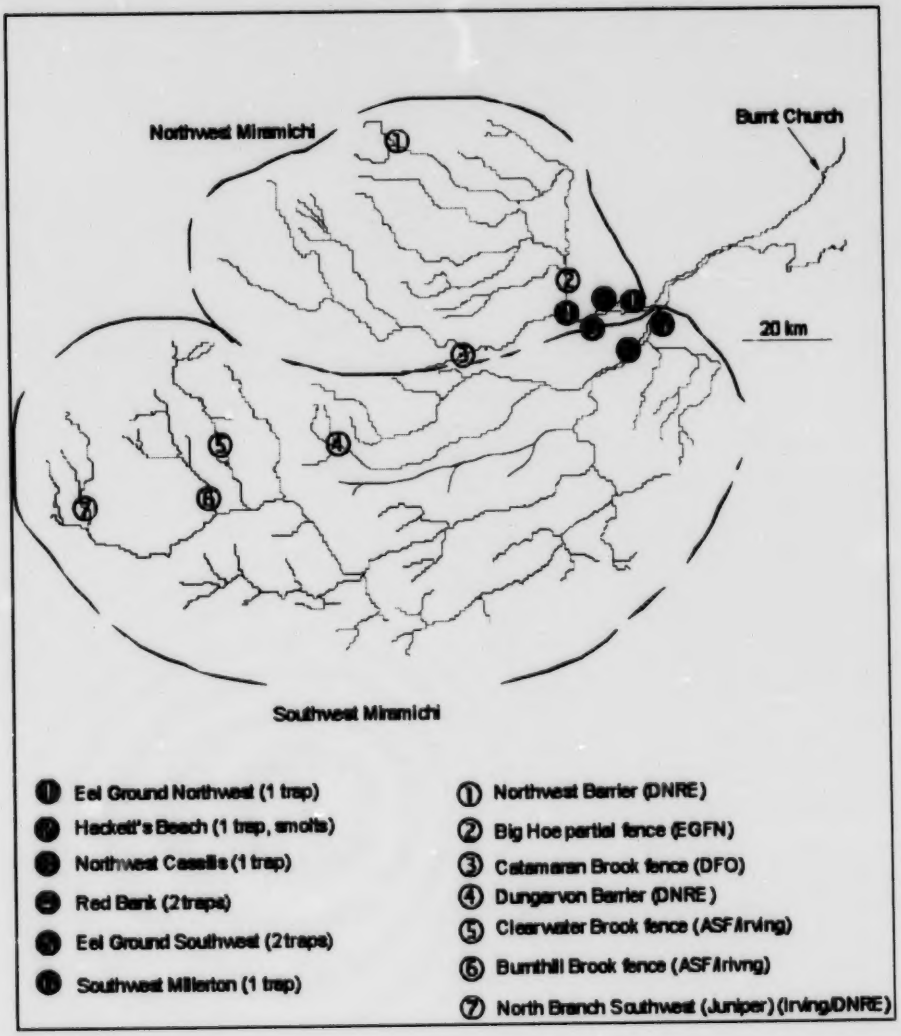


Figure 1. The Miramichi River indicating major branches, major tributaries and location of trapnets and counting fences operated in 2000.

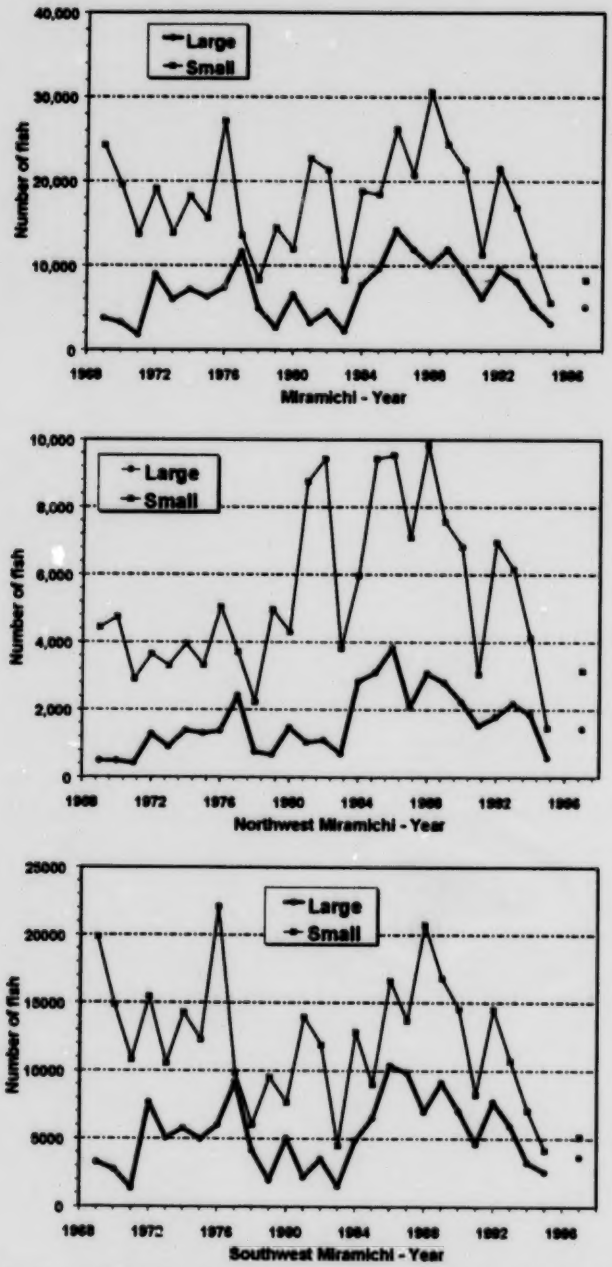


Figure 2. Angling trends of small (harvest) and large (catch) salmon from the Miramichi River (top), Northwest Miramichi (middle) and Southwest Miramichi (bottom) rivers. 1996 data are not available. The 1998 to 2000 data are not available.

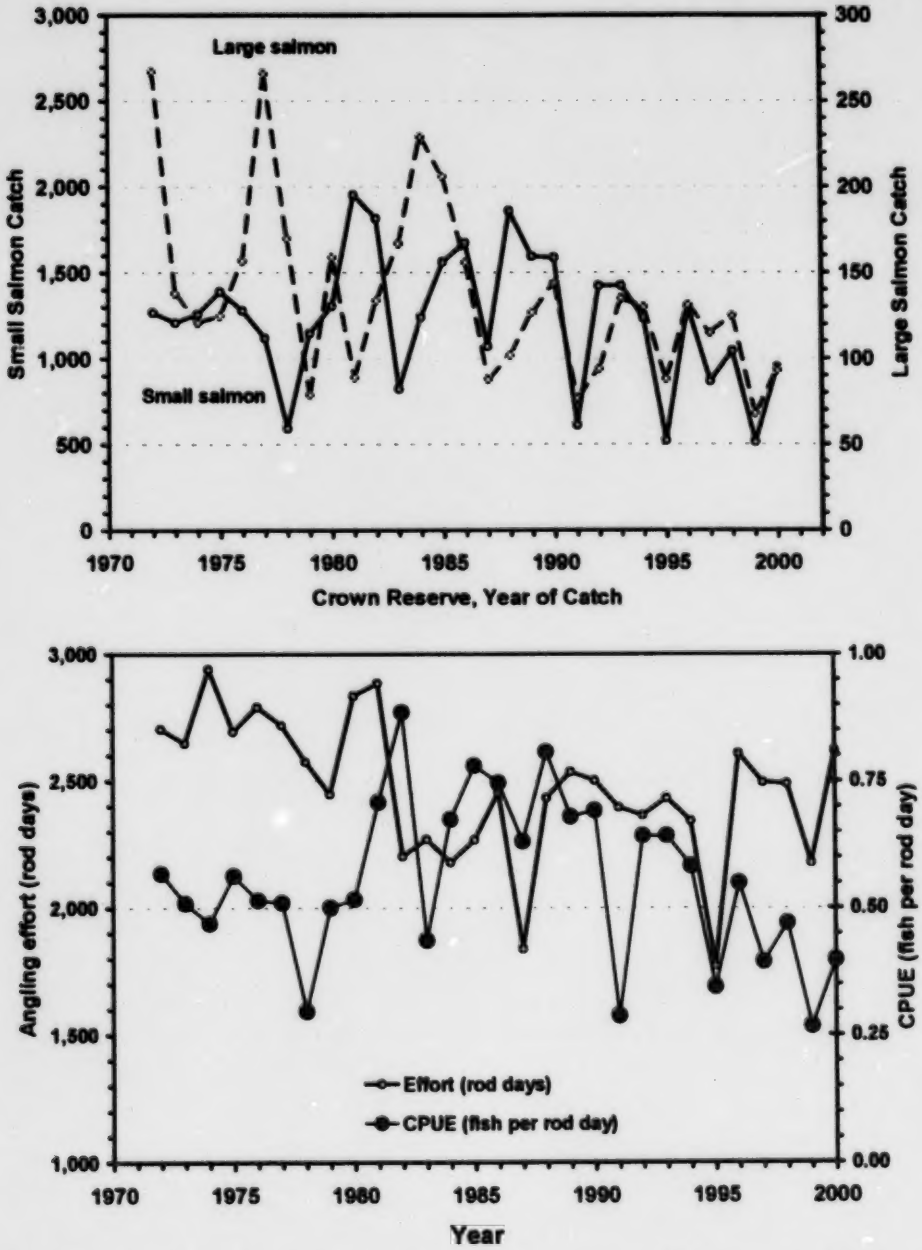
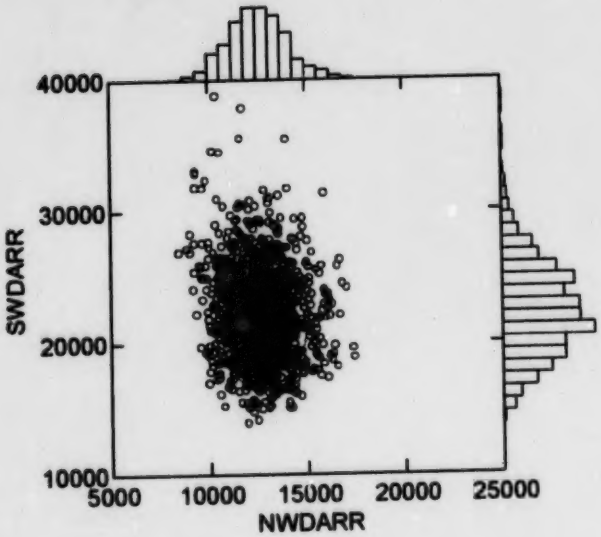


Figure 3. Trends in catches of small salmon and large salmon (upper panel) and angling effort and catch per unit effort (lower panel) from the Crown Reserve waters of the Northwest Miramichi, 1972 to 2000.



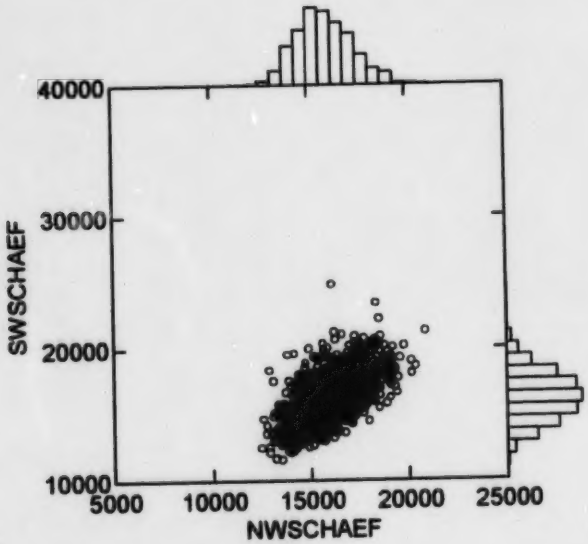
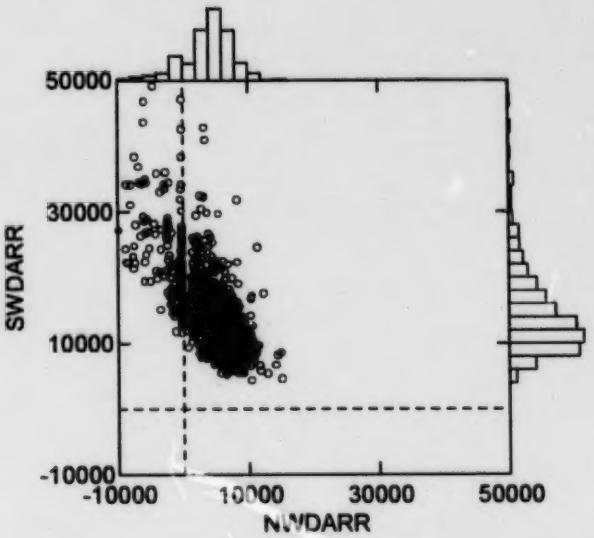


Figure 4a. Estimated return of small salmon to the Northwest and Southwest Miramichi in 2000 based on the Darroch model (upper) and the Schaefer model (lower). Results are from 1000 simulations.



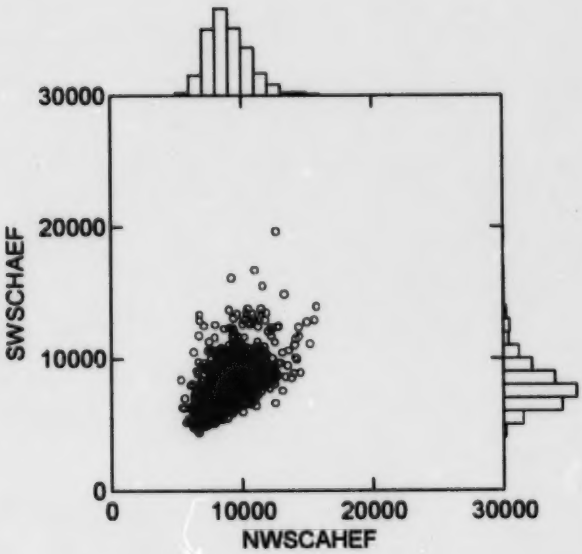


Figure 4b. Estimated return of large salmon to the Northwest and Southwest Miramichi in 2000 based on the Darroch model (upper) and the Schaefer model (lower).

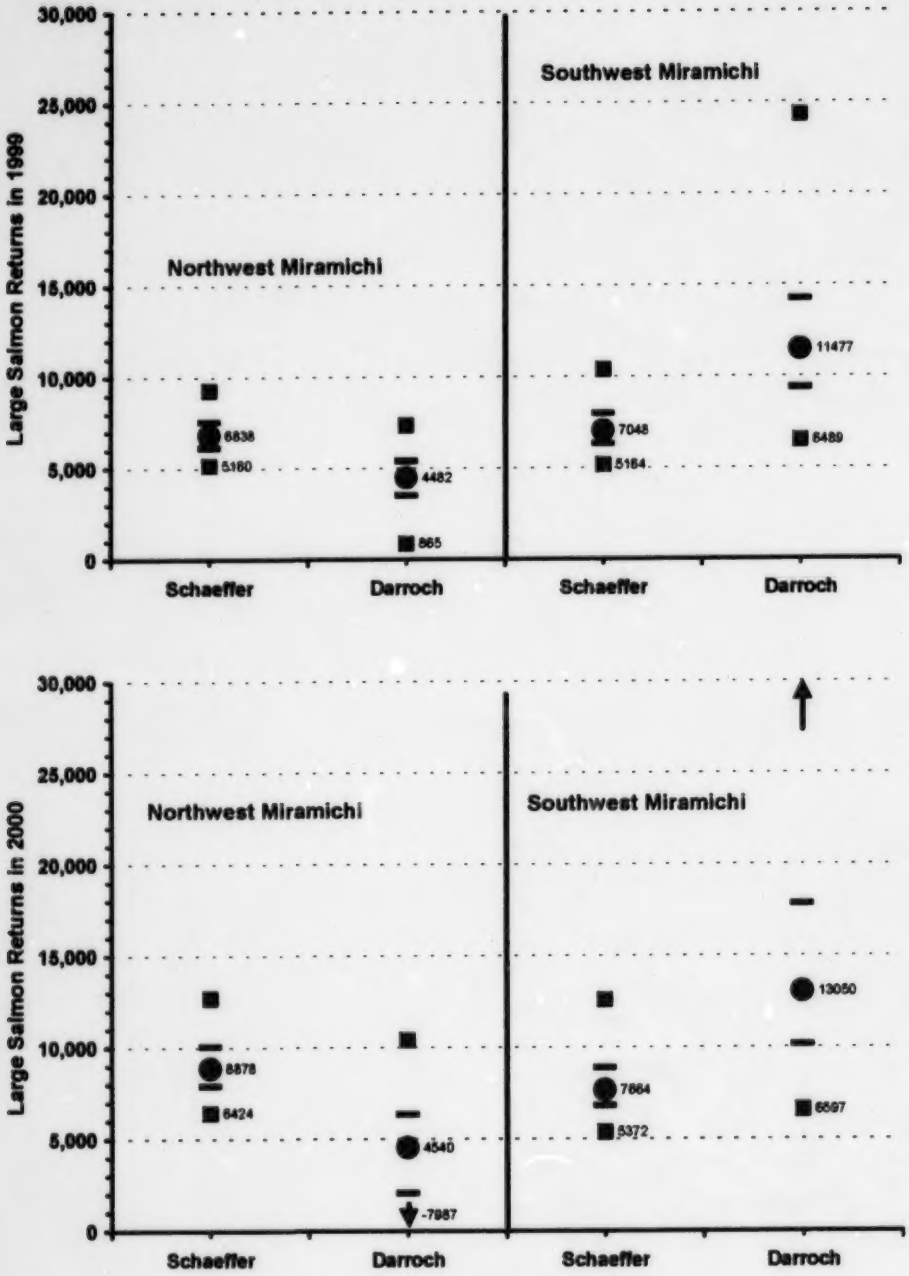


Figure 5a. Estimated returns of large salmon to the Northwest Miramichi and the Southwest Miramichi in 1999 (upper) and 2000 (lower). Numerical values displayed in each case are the actual estimate and the lower value for the 95% confidence interval of the estimate.

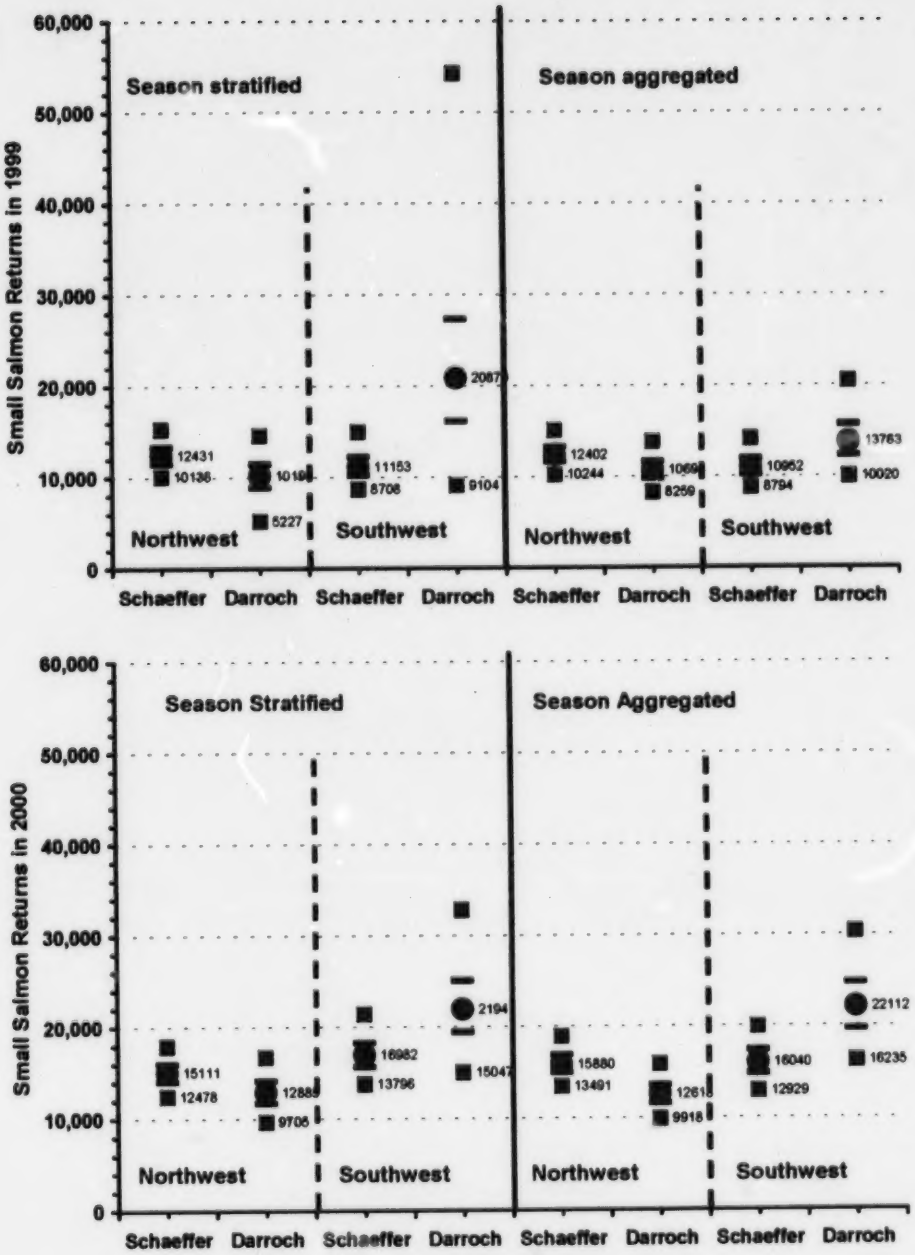


Figure 5b. Estimated returns of small salmon to the Northwest Miramichi and the Southwest Miramichi in 1999 (upper) and 2000 (lower). Numerical values displayed in each case are the actual estimate and the lower value for the 95% confidence interval of the estimate.

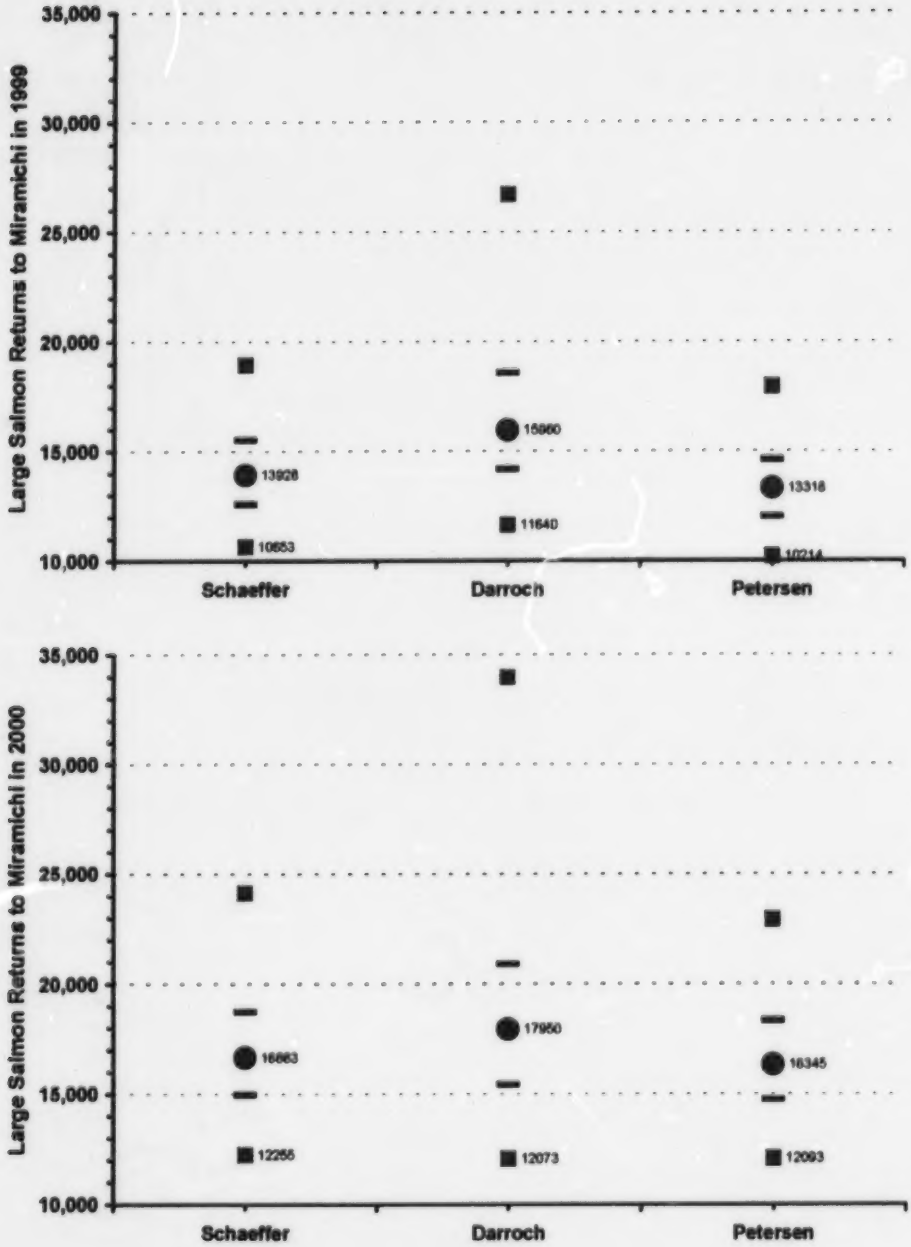
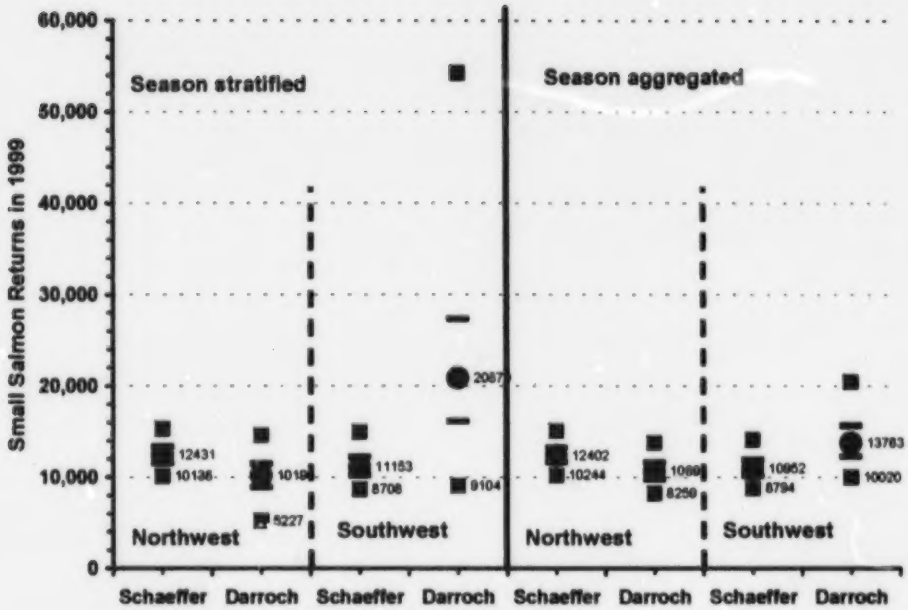


Figure 5c. Estimated returns of large salmon in 1999 (upper) and 2000 (lower) for the Miramichi River. Numerical values displayed in each case are the actual estimate and the lower value for the 95% confidence interval of the estimate.



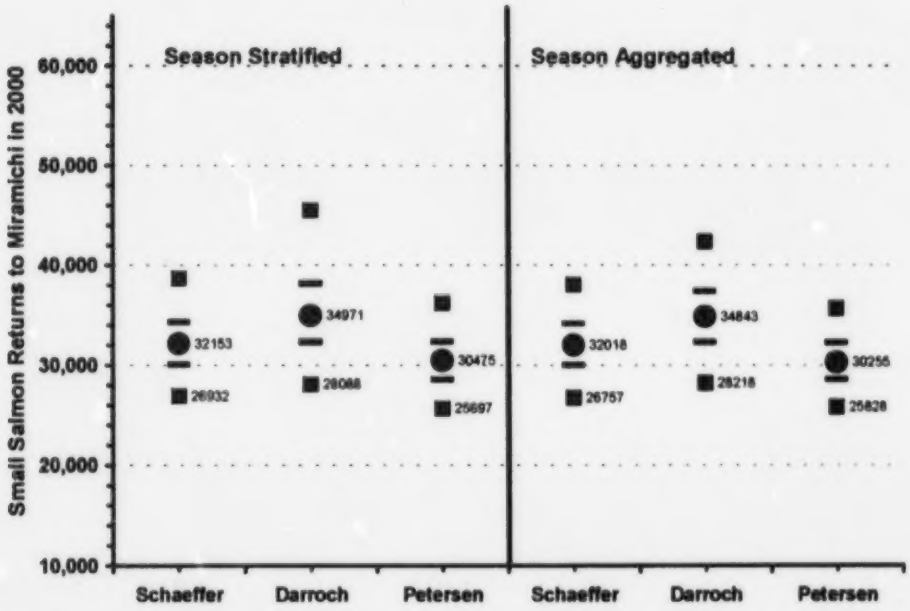


Figure 5d. Estimated returns of small salmon in 1999 (upper) and 2000 (lower) for the Miramichi River. Numerical values displayed in each case are the actual estimate and the lower value for the 95% confidence interval of the estimate.

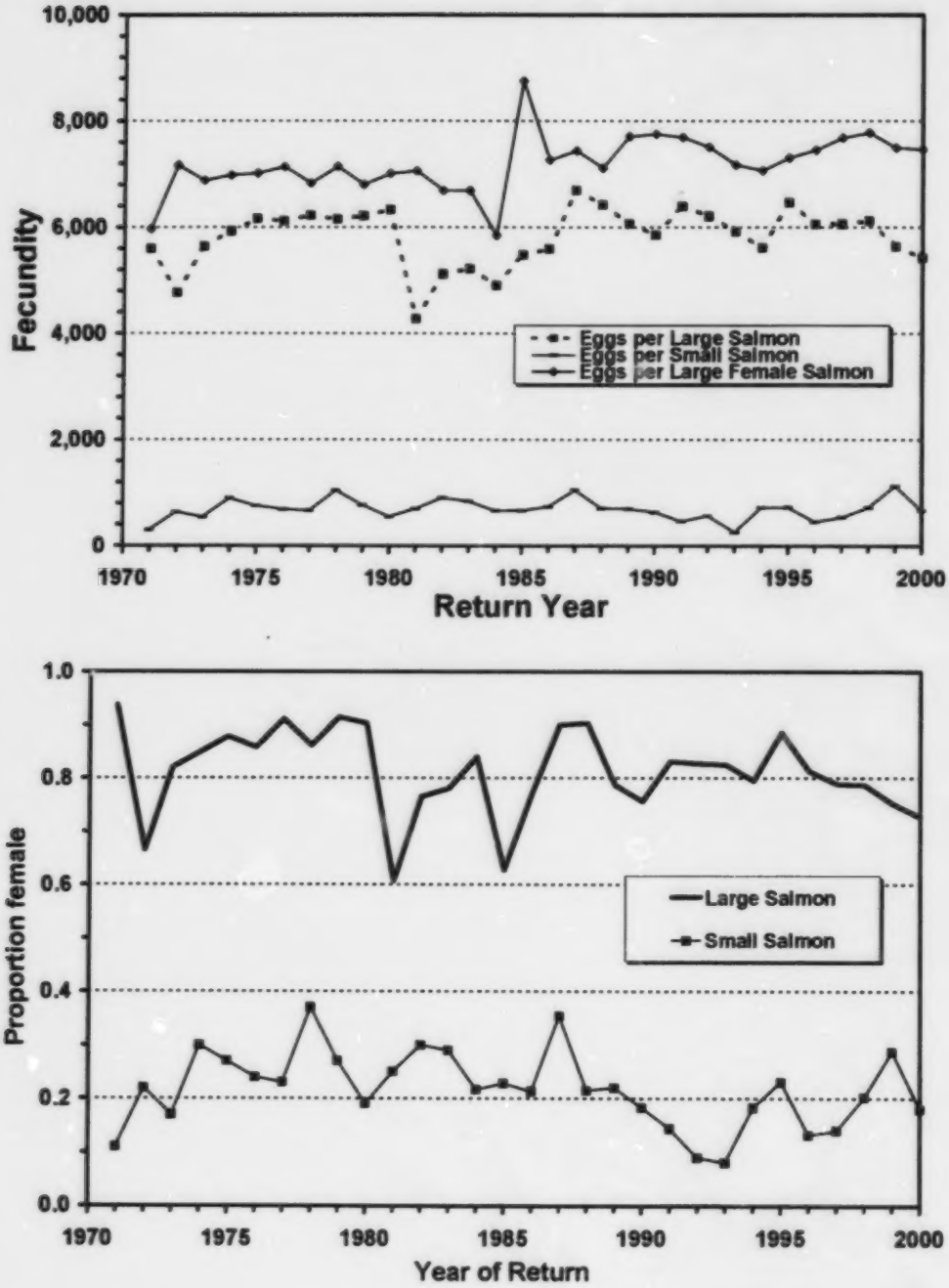


Figure 6. Annual variation in the fecundity (upper, number of eggs) and proportions female (lower) of small and large salmon from the Miramichi River, 1971 to 2000.

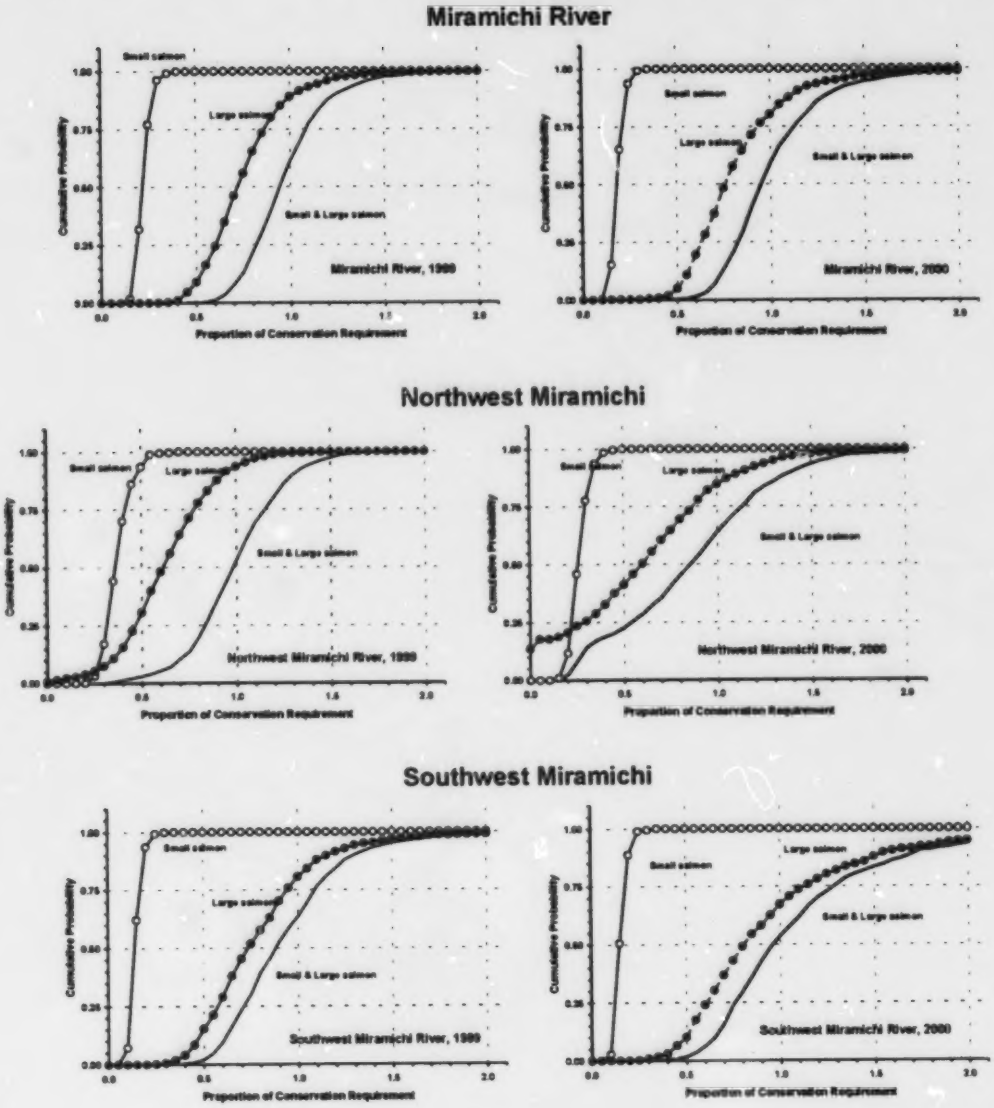


Figure 7. Eggs in the returns expressed as the proportion of the conservation requirements (2.4 eggs per m^2) in the Miramichi River overall (top), Northwest Miramichi (middle) and Southwest Miramichi (bottom) by small salmon, large salmon, small and large combined in 1999 (left panels) and 2000 (right panels).

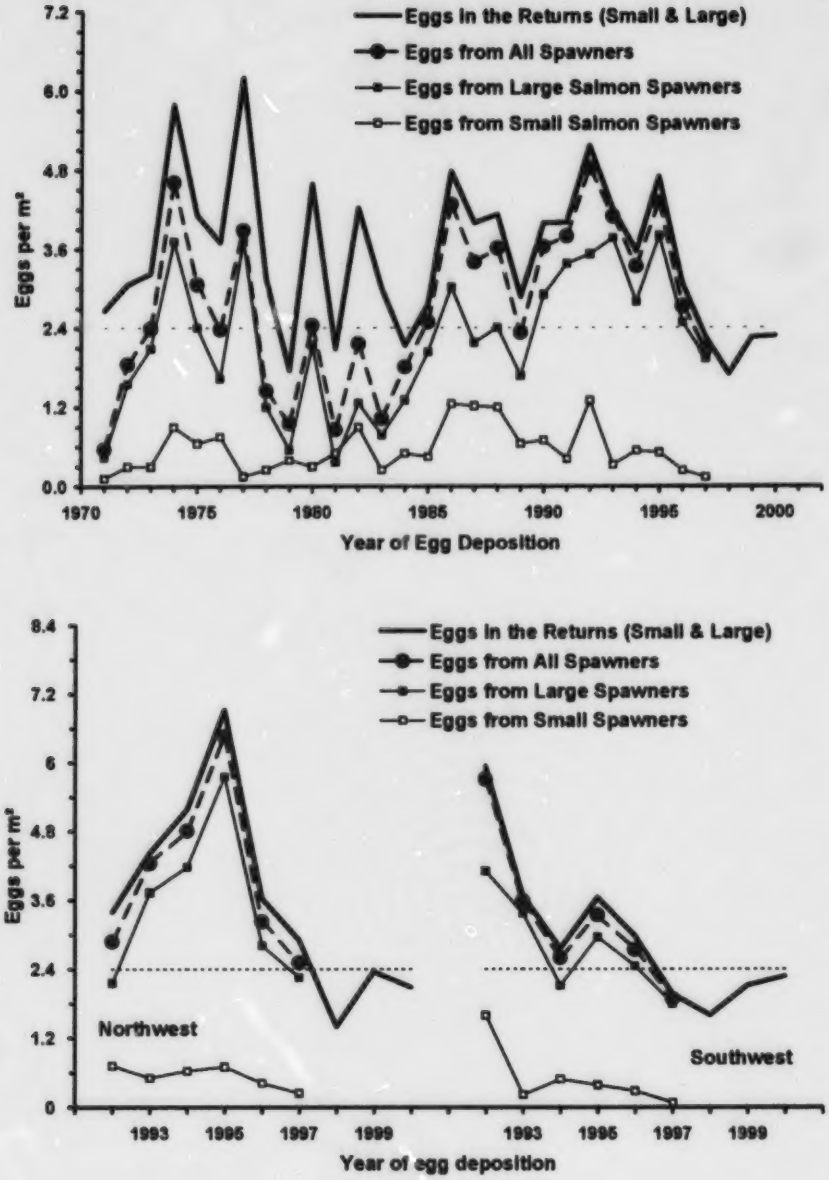


Figure 8. Point estimate of eggs in the total returns of small salmon and large salmon to the Miramichi River (upper) and to the Northwest and Southwest branches of the Miramichi (lower) and annual egg depositions (eggs per m^2) by small and large salmon (solid circle and bold line), by large salmon (small square and narrow line) and by small salmon (small square and thin line). Dashed line is the conservation egg requirement of 2.4 eggs per m^2.

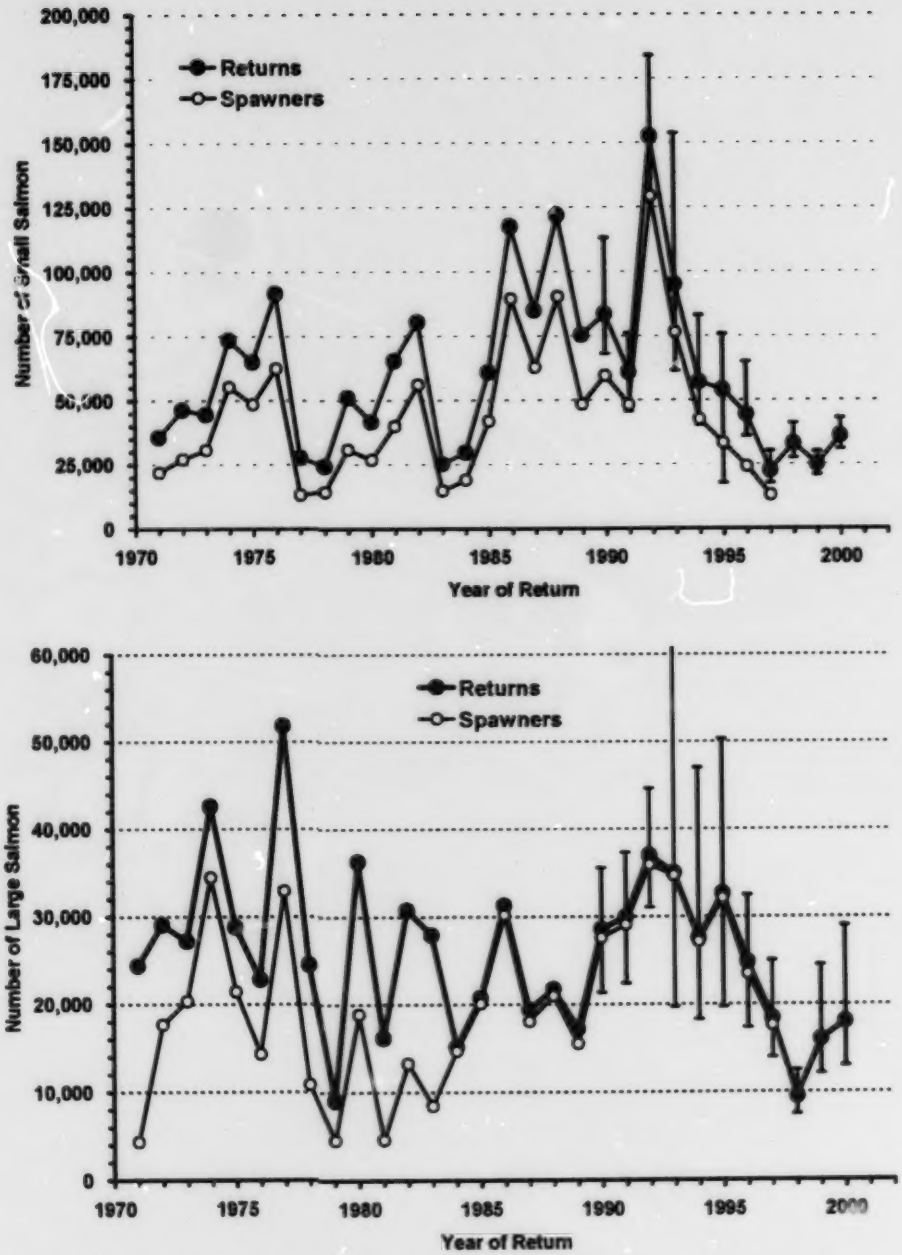


Figure 9. Estimates of total returns to the Miramichi River estuary and number of spawners for small salmon (upper) and large salmon (lower), 1971 to 2000. The vertical lines represent the 90% confidence limit range of the estimated returns.

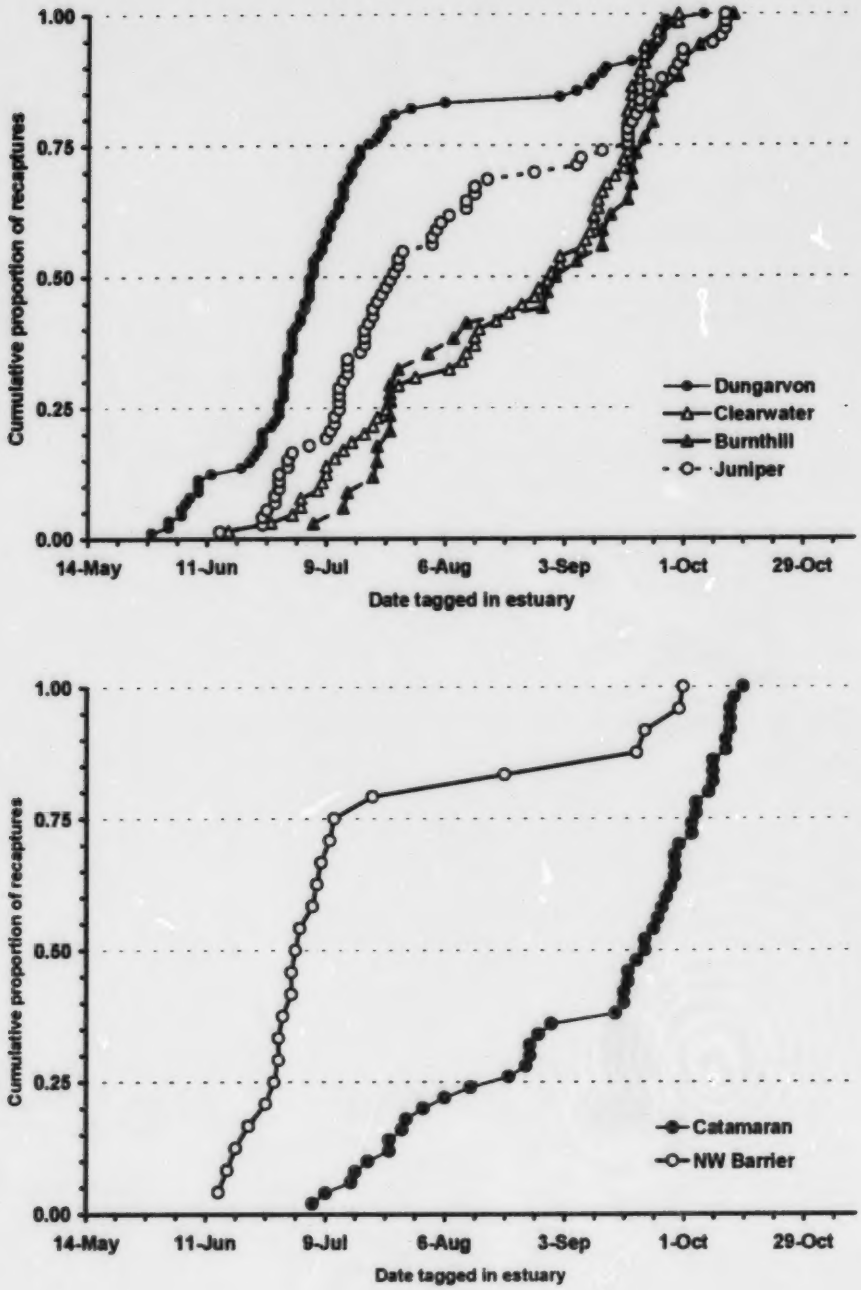
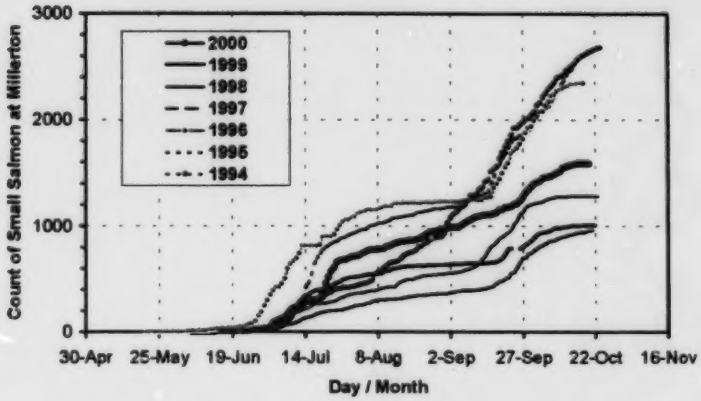
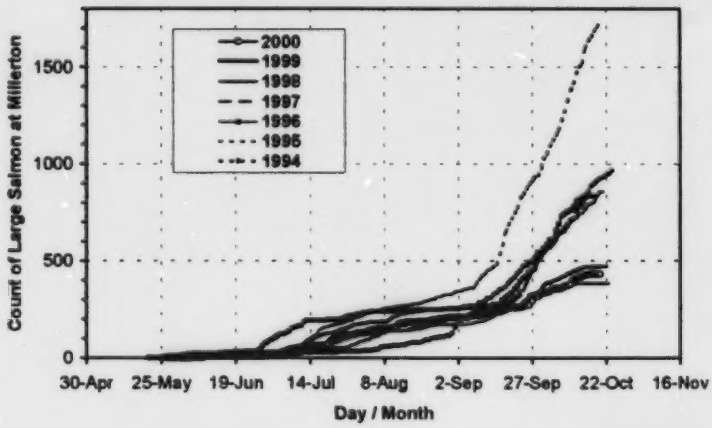


Figure 10. Season of return to the estuary of salmon recovered at barrier fences and counting fences in the Southwest Miramichi (upper) and the Northwest Miramichi (lower). Tag recoveries are the total for 1995 to 2000.



Small Salmon

Year	Percentage by Jul-31	Percentage by Aug. 31
1994	18%	35%
1995	36%	44%
1996	48%	62%
1997	26%	38%
1998	29%	43%
1999	51%	63%
2000	45%	61%



Large Salmon

Year	Percentage by Jul-31	Percentage by Aug. 31
1994	4%	13%
1995	12%	19%
1996	27%	38%
1997	16%	24%
1998	32%	45%
1999	37%	53%
2000	29%	48%

Figure 11a. Timing of small salmon (upper) and large salmon (lower) catches at the Millerton trapnet in the Southwest Miramichi, 1994 to 2000.

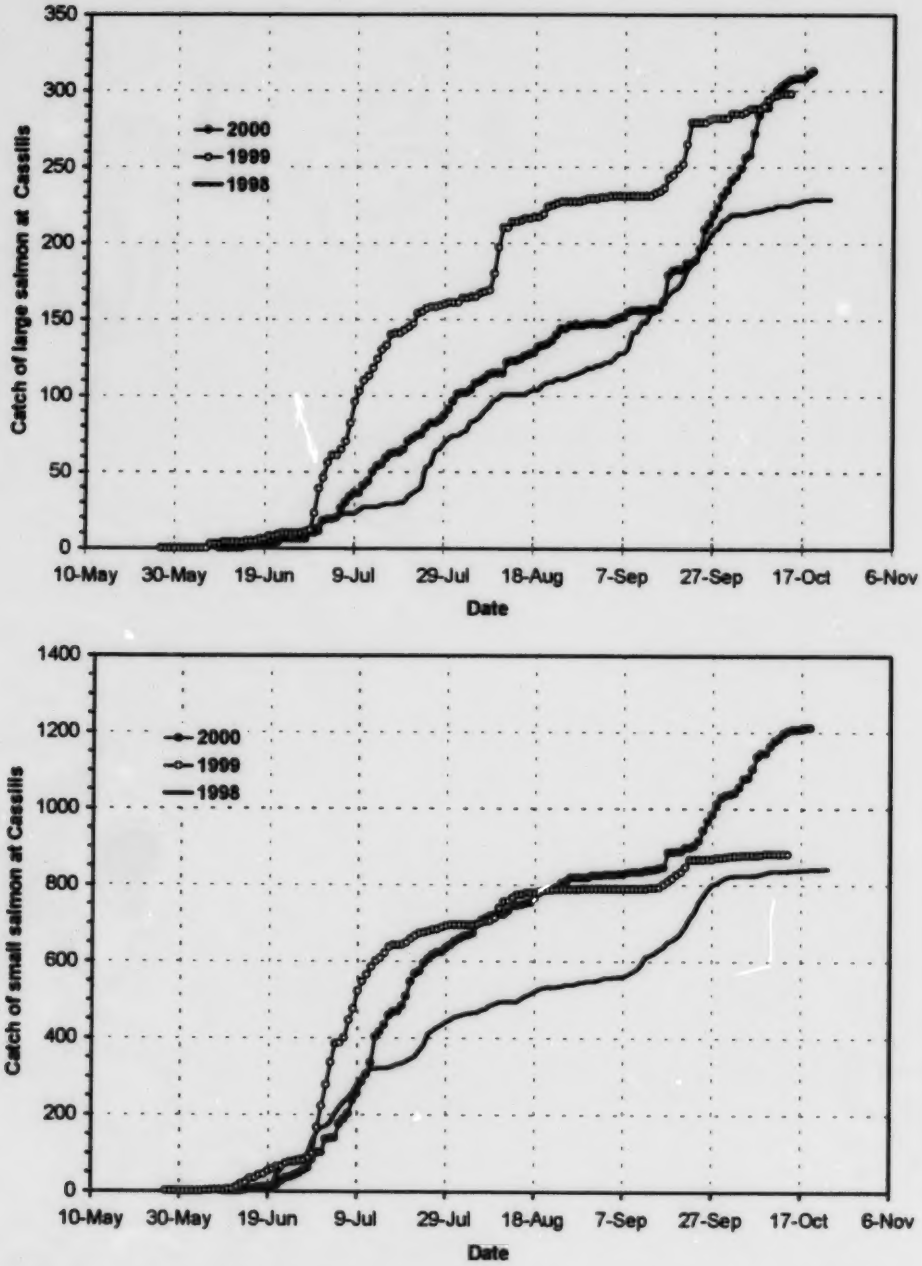


Figure 11b. Timing of small salmon (upper) and large salmon (lower) catches at the Cassilis trapnet in the Northwest Miramichi, 1998 to 2000.

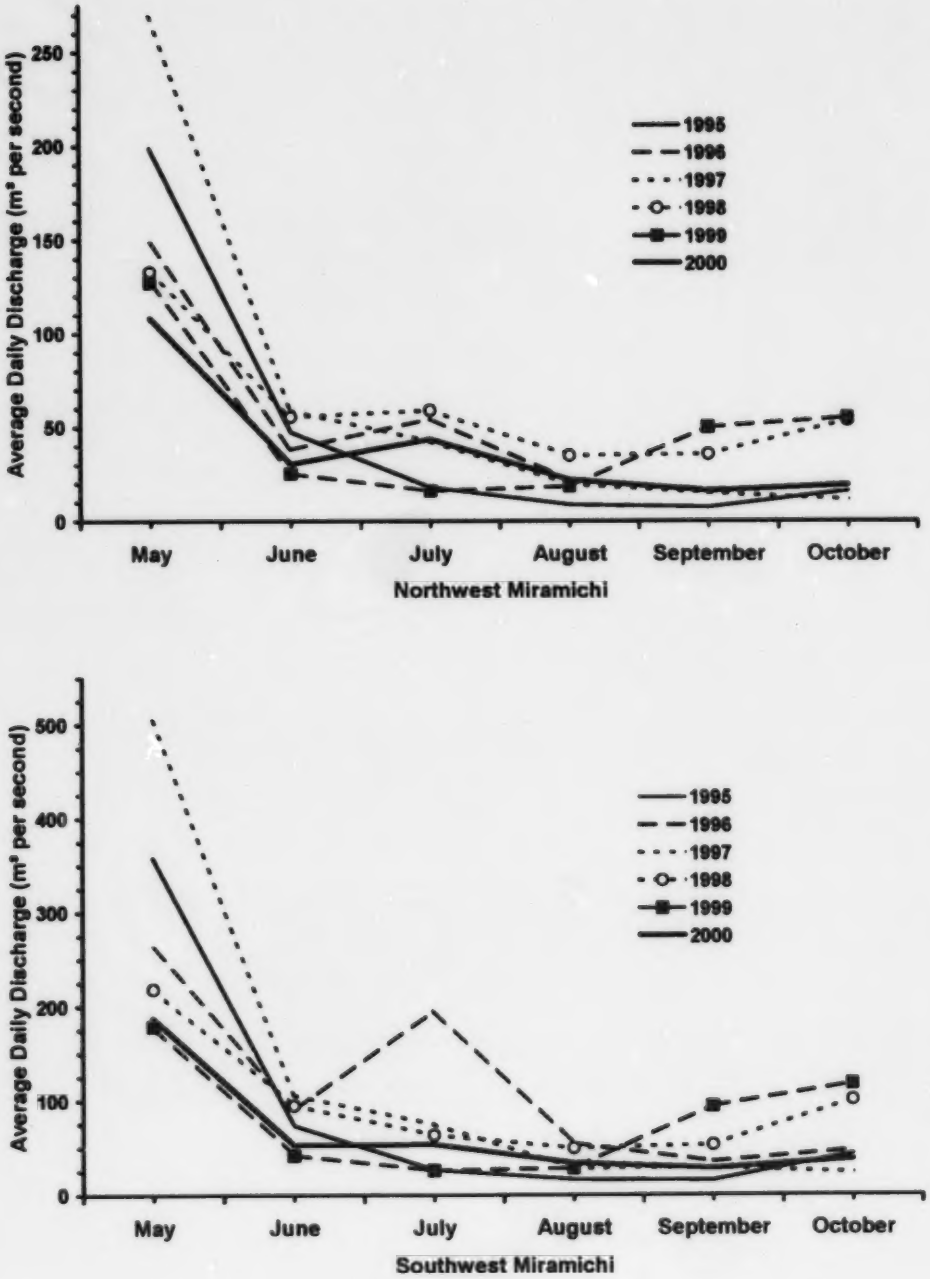


Figure 12. Mean daily discharge (m^3 per sec) profiles by month for the Northwest Miramichi (upper), and Southwest Miramichi (lower), 1995 to 2000.

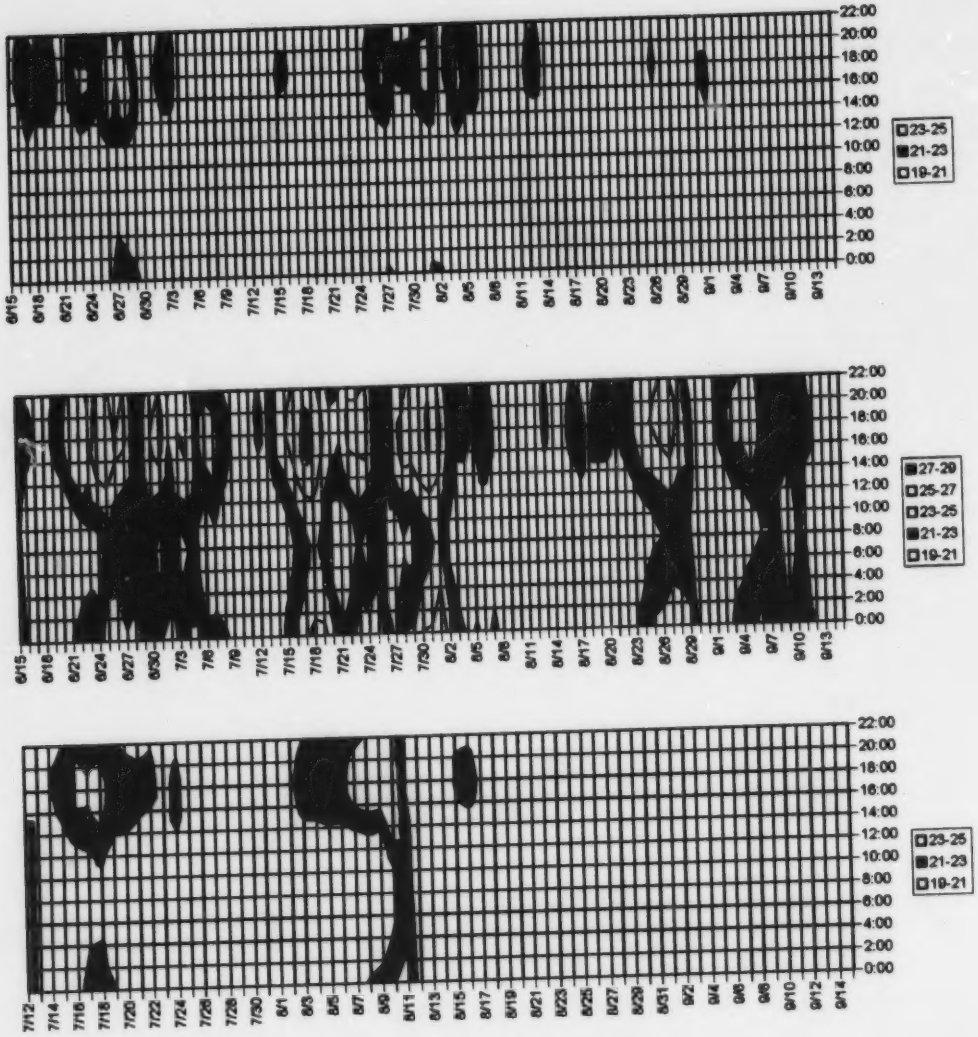


Figure 13a. Hourly water temperatures in the Little Southwest Miramichi (at Upper Oxbow) in 2000 (upper), 1999 (middle) and 1998 (lower).

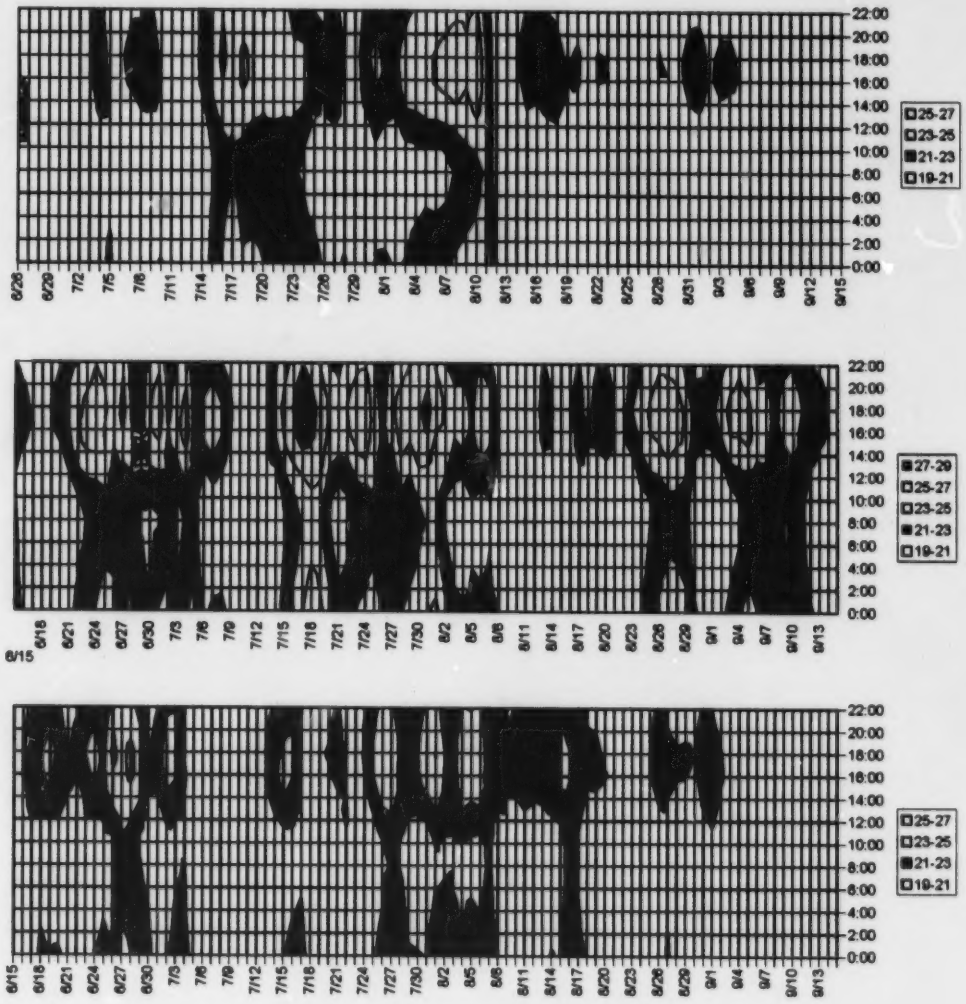


Figure 13b. Hourly water temperatures in the main Southwest Miramichi (at Wades Lodge) in 2000 (upper), 1999 (middle) and 1998 (lower).

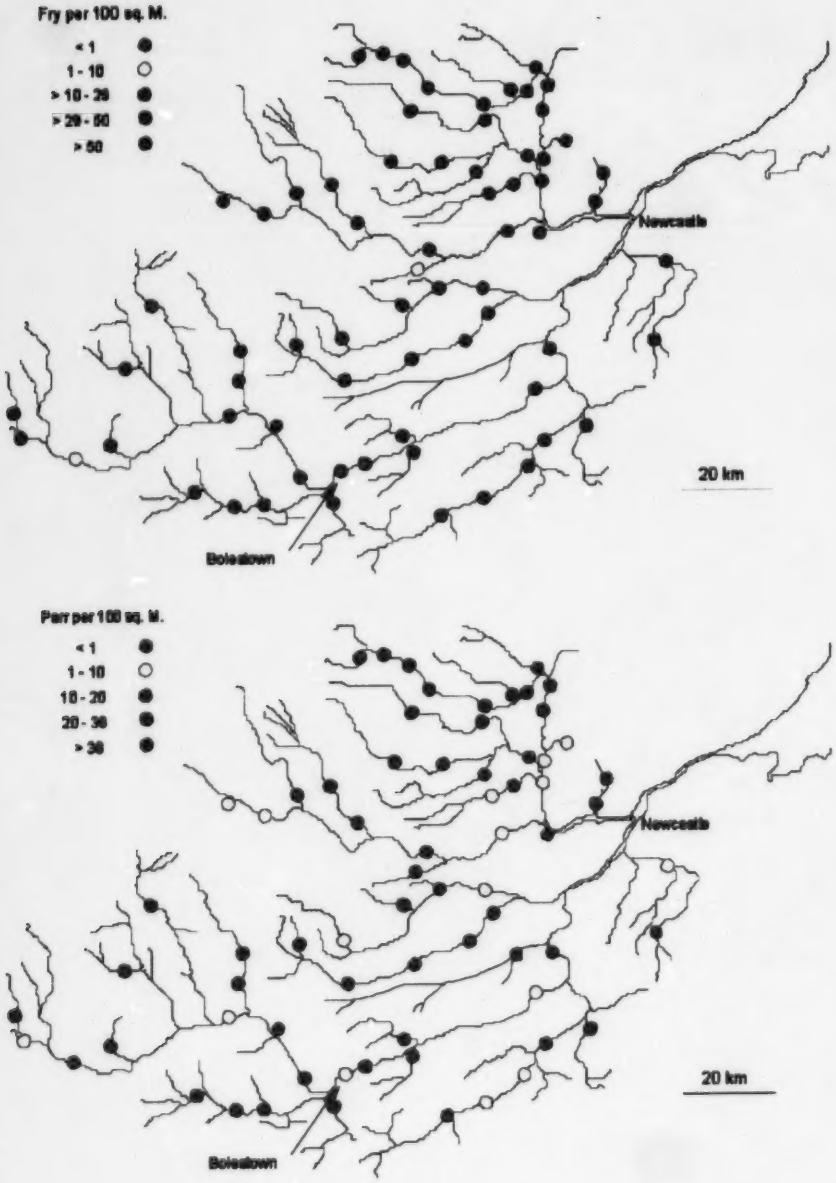


Figure 14. Observed fry (upper) and parr (lower) densities in the Miramichi River in 2000.

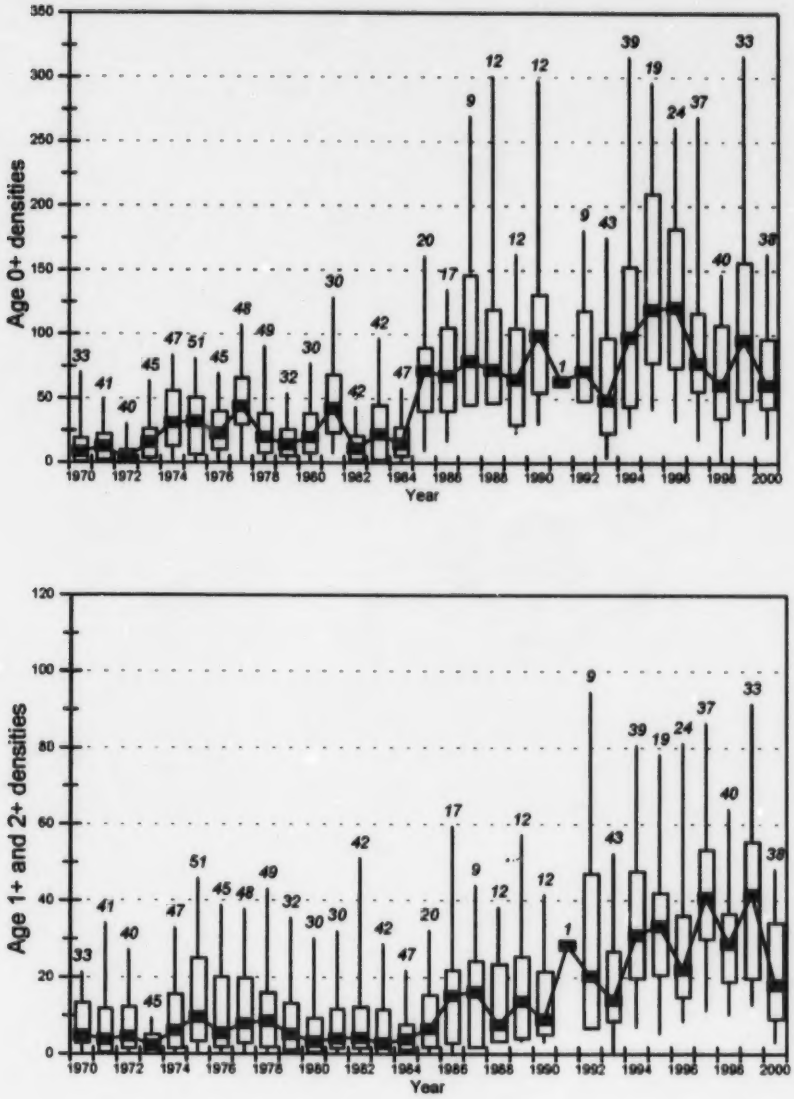


Figure 15. Atlantic salmon fry (upper) and parr (lower) densities (fish per 100 m^2) at all sampled sites in the Southwest Miramichi, 1970 to 2000. Box plots are interpreted as follows: vertical line = 5th to 95th percentile range, box = 25th to 75th percentile range, square = median value. Number above the vertical line is the number of sites sampled.

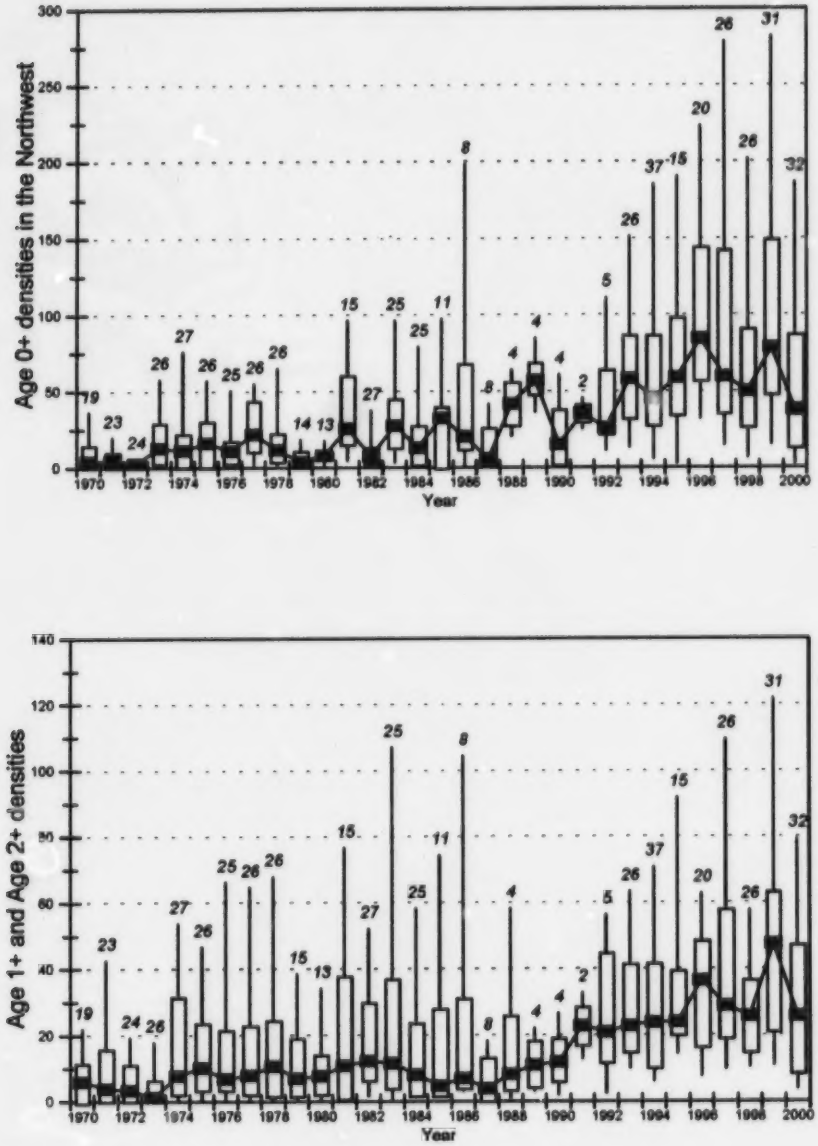


Figure 16. Atlantic salmon fry (upper) and parr (lower) densities (fish per 100 m^2) at all sampled sites in the Northwest Miramichi, 1970 to 1999. Box plots are interpreted as in Figure 15.

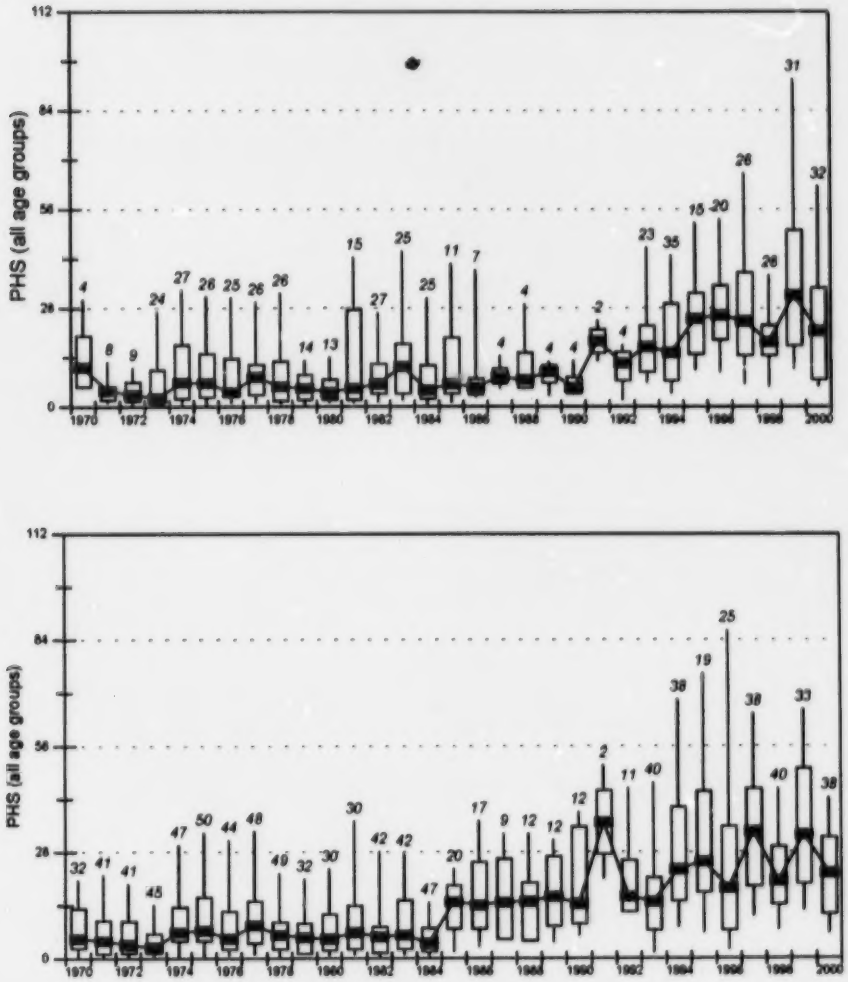


Figure 17. Percent habitat saturation (PHS) index of juvenile Atlantic salmon at all sampled sites in the Southwest Miramichi (upper) and four index sites in the Northwest Miramichi (lower) for 1970 to 2000. Box plots are interpreted as in Figure 15.

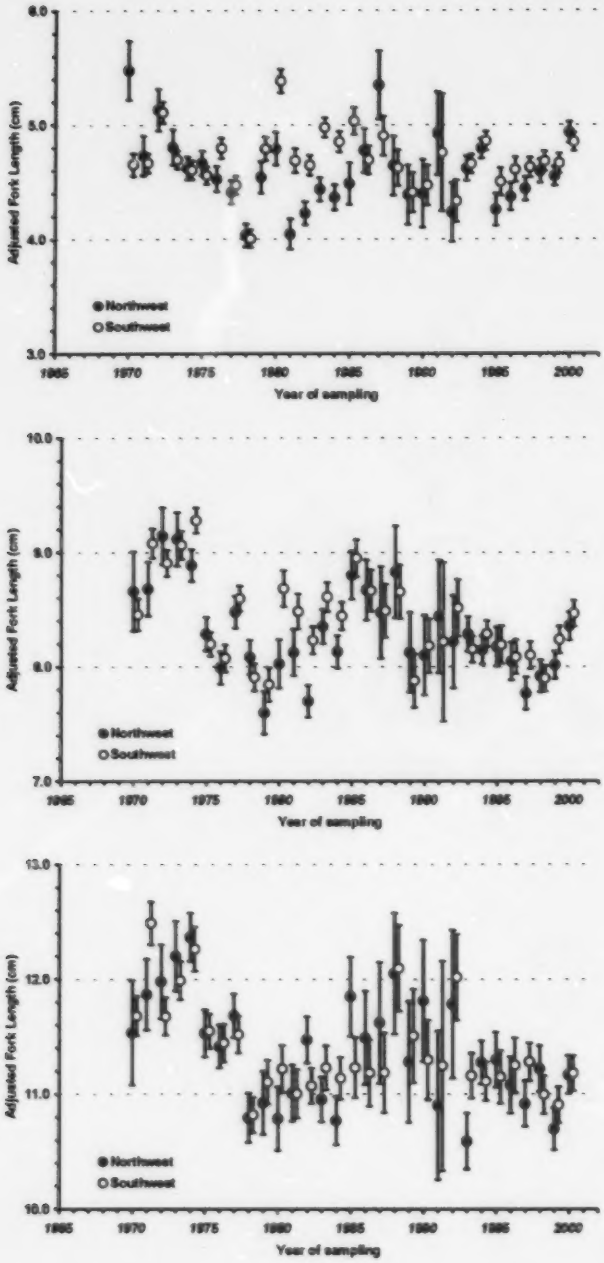


Figure 18. Adjusted mean size at age (mean +/- 1 std. error) of salmon juveniles from the Northwest and Southwest branches of the Miramichi River. Size is adjusted for date of sampling (average sampling date over the time series of 14 August and assuming a linear change in growth over time) and density. There was minimal difference in adjusted size assuming a different growth relationship over time.

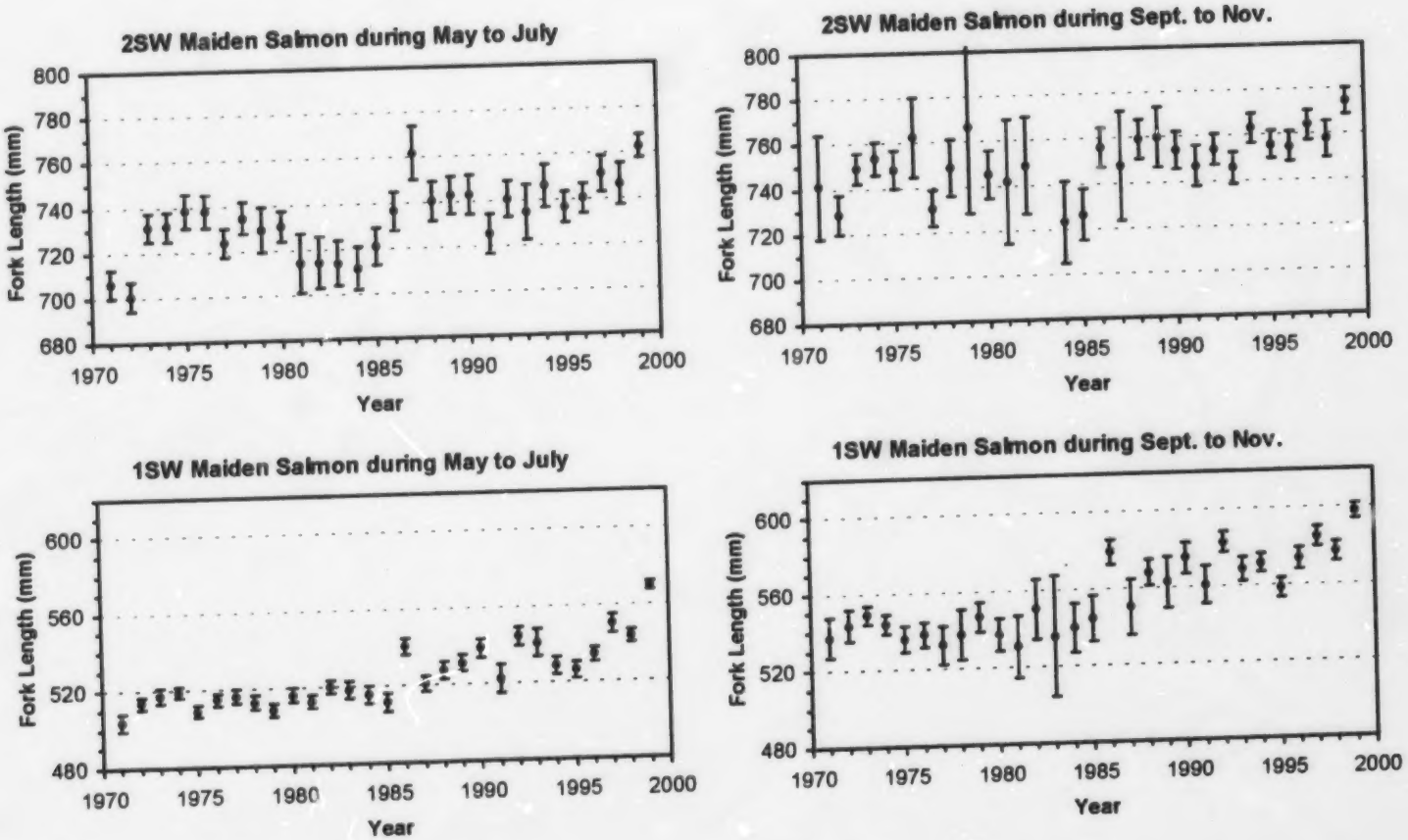


Figure 19. Fork length (mean ± 2 standard errors) of 2SW maiden salmon (upper panels) and 1SW maiden salmon (lower panels) for the summer run (May to July - left panels) and the fall run (Sept. to Nov. - right panels) from the Miramichi River, 1971 to 1999.

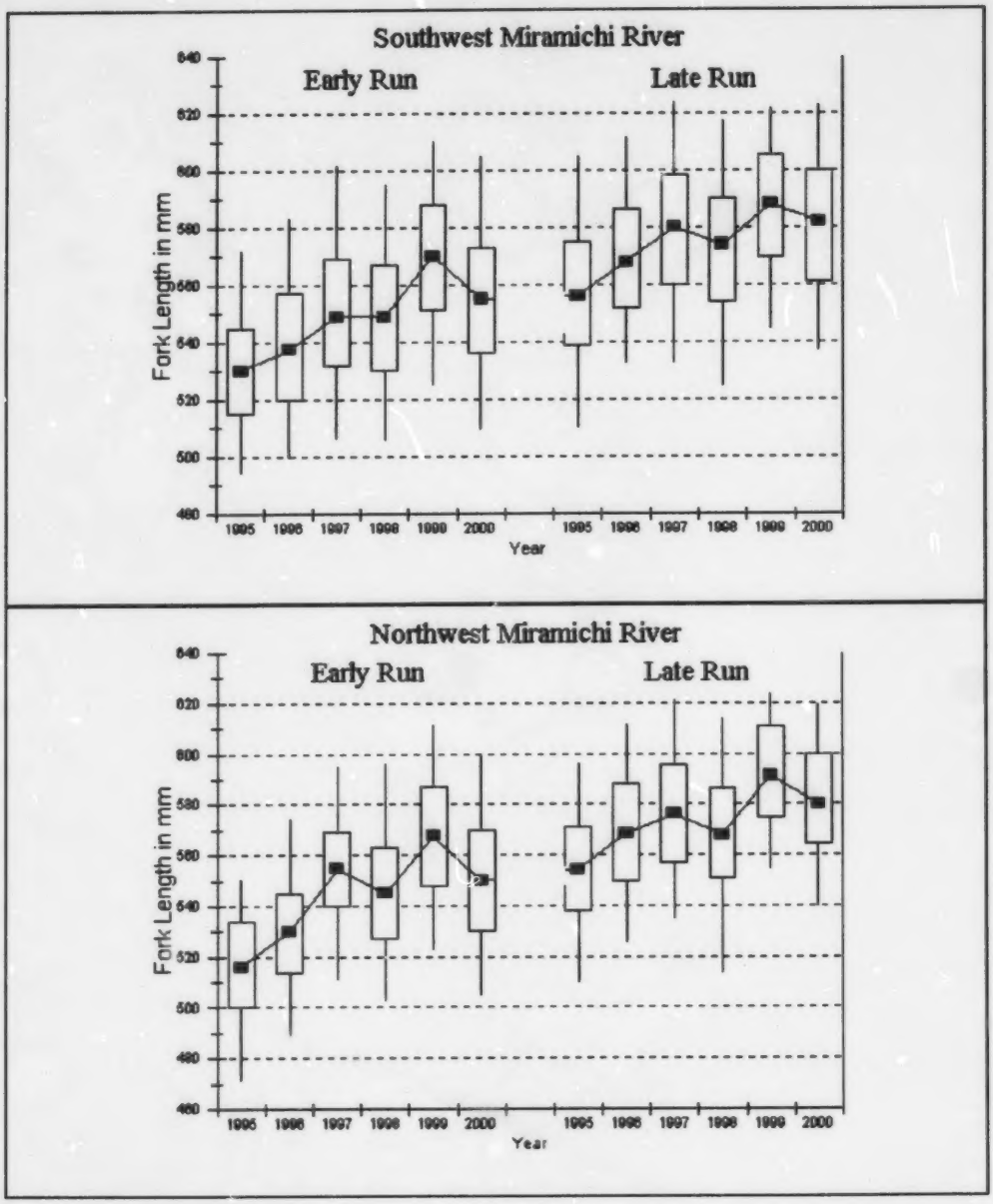


Figure 20. Fork length for small salmon (predominantly 1SW salmon) in the Southwest (upper) and Northwest (lower) Miramichi rivers from 1995 to 2000. Box plots show median, 5th, 25th, 75th, and 95th percentiles.

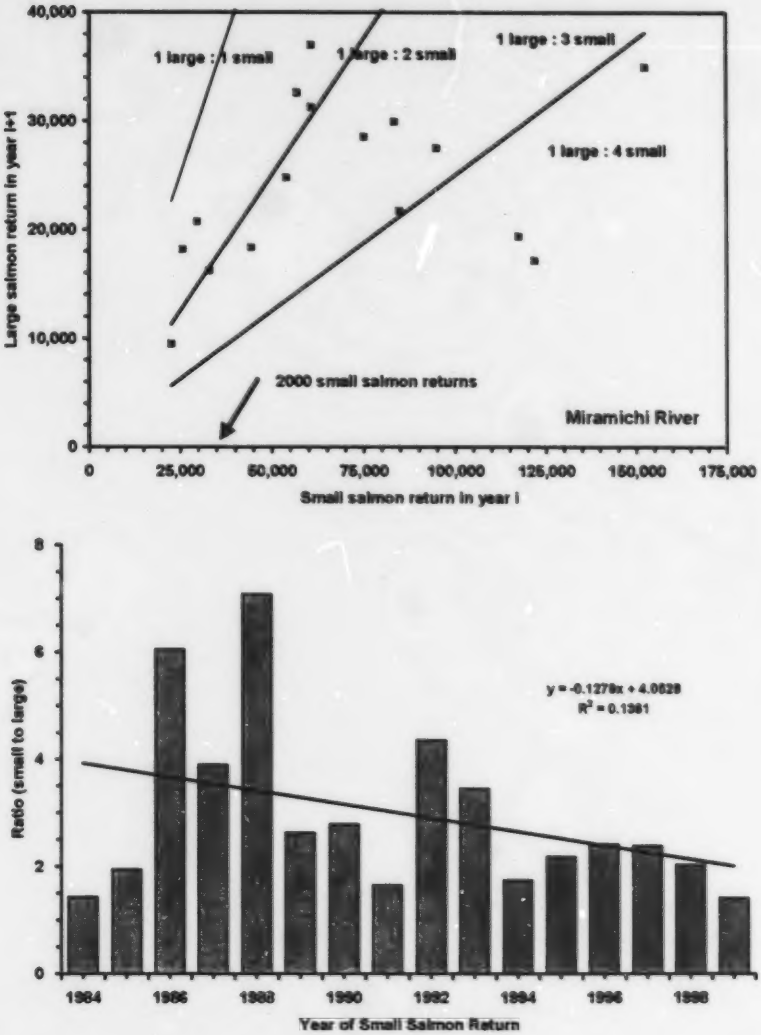


Figure 21. Small salmon returns in year i to large salmon returns in year i +1 for the Miramichi River (upper) and the ratio for the period 1984 to 1999 (lower). The median small salmon to large salmon ratio for the recent five years is 2.18.

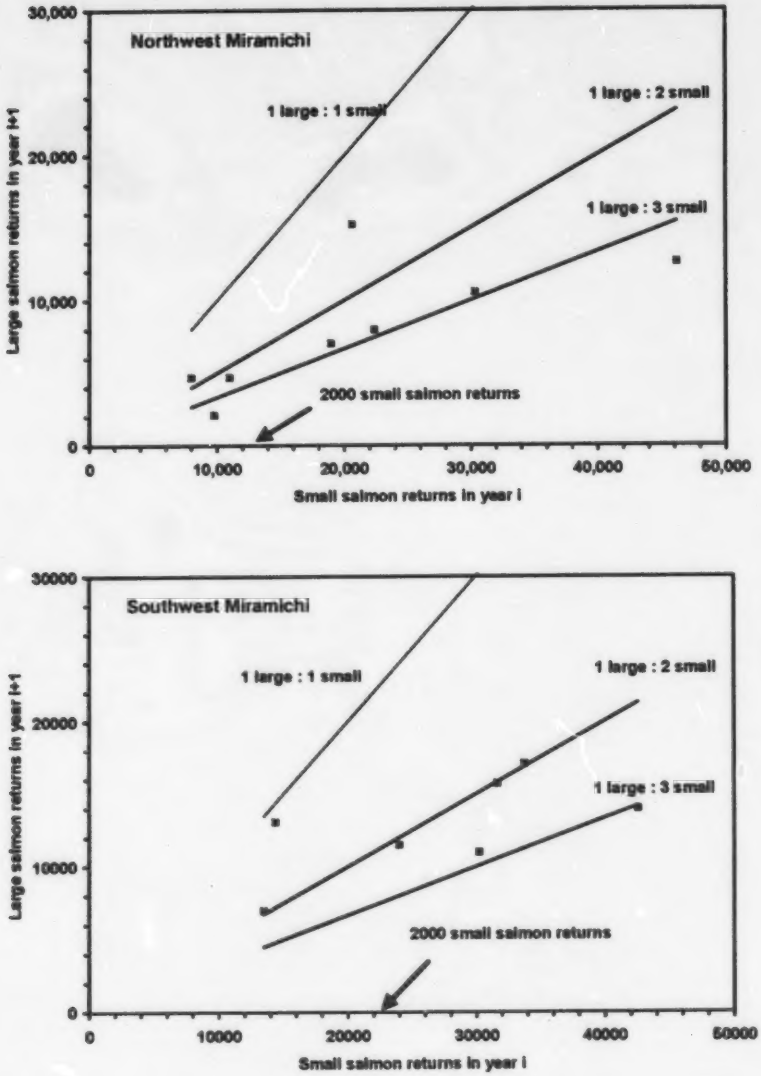


Figure 22. Small salmon returns in year i to large salmon returns in year i +1 for the Northwest Miramichi (upper) and the Southwest Miramichi (lower) for the period 1992 to 2000. The median small salmon to large salmon ratio for the recent five years is 2.70 for the Northwest Miramichi and 2.02 for the Southwest Miramichi.

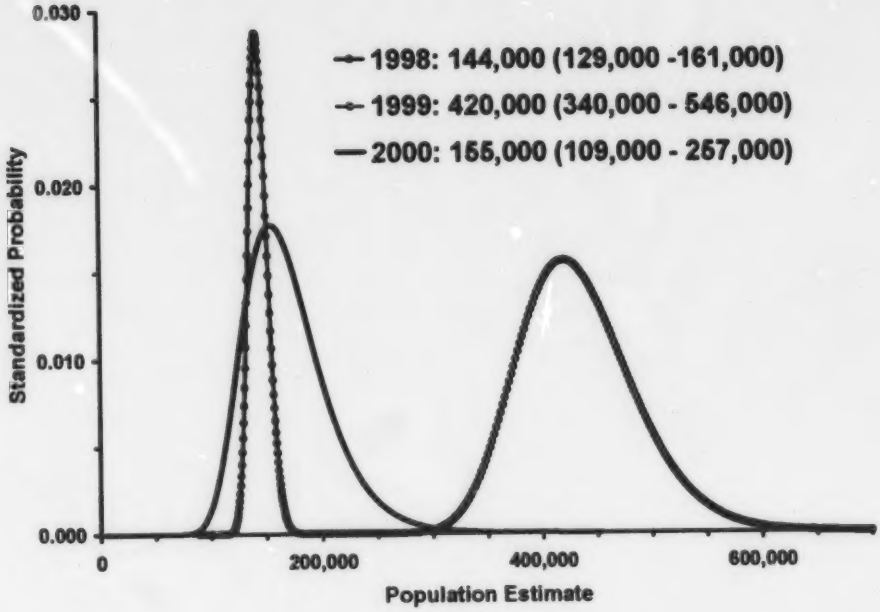


Figure 23. Population estimate profiles of Atlantic salmon smolts from the Northwest Miramichi in 1998 to 2000. The 1998 estimate is considered to be an underestimate of the smolt run because of a partial count of the smolts during two events.

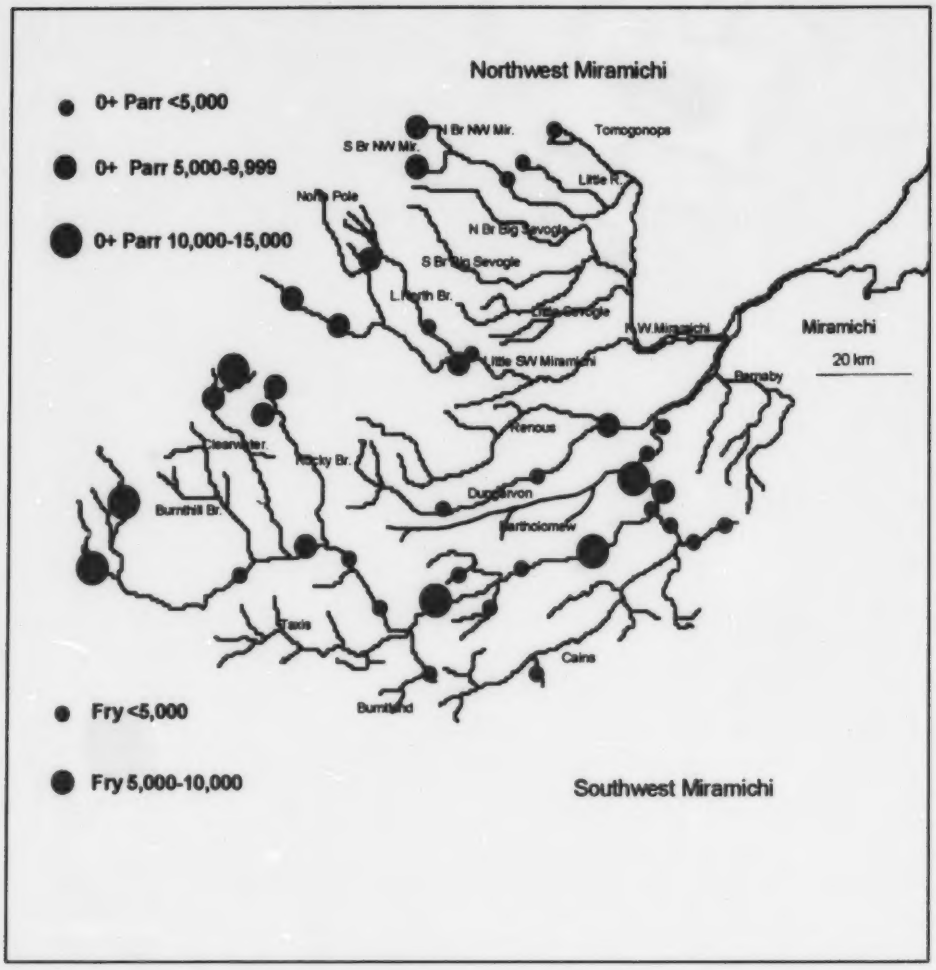


Figure 24. Distribution sites of juvenile Atlantic salmon from the Miramichi Salmon Conservation Centre, South Esk, NB and satellite rearing sites in the Miramichi river, 2000. Fry refers to non-feeding fry stocking. 0+ parr refers to stocking of feeding life stages.

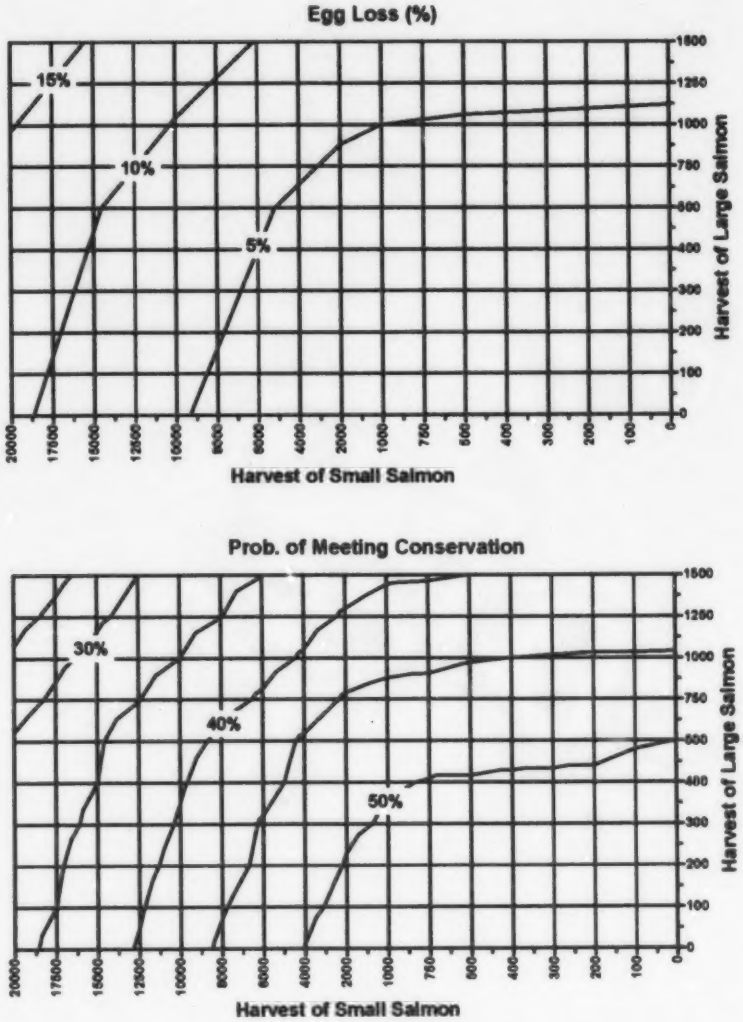
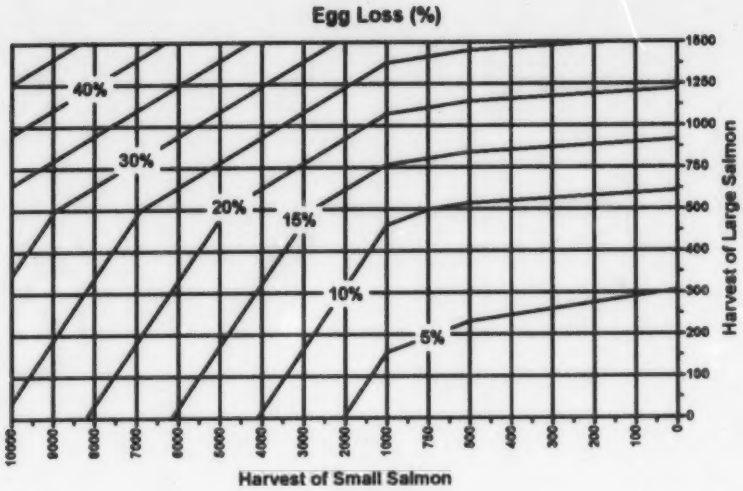


Figure 25. Egg loss (upper) expressed as the percentage of the eggs in the total returns of Atlantic salmon and probability of meeting conservation egg requirements after fisheries (lower) for the Miramichi River in 2001 relative to harvests of small salmon and large salmon.



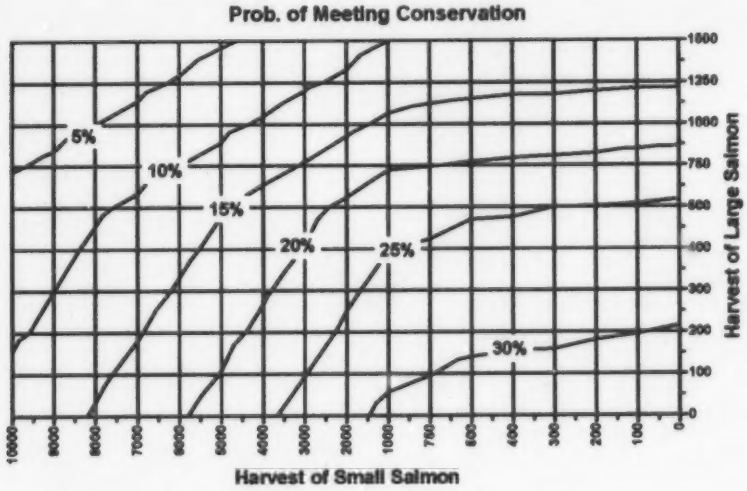
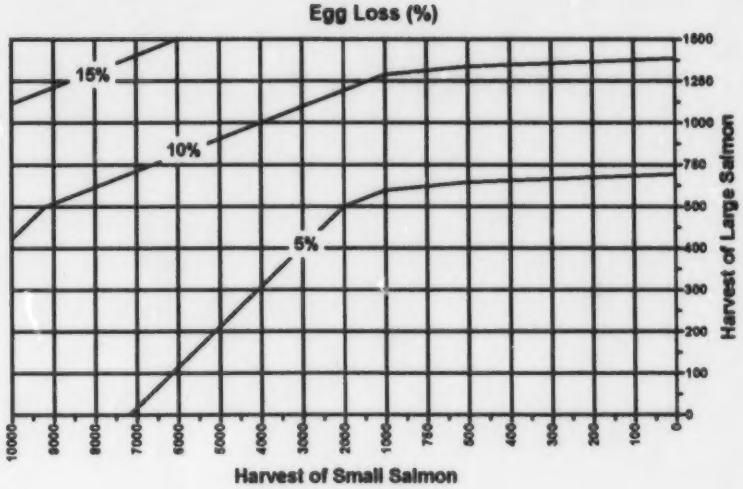


Figure 26. Egg loss expressed as the percentage of the eggs in the total returns of Atlantic salmon to the Northwest Miramichi River (upper) and probability of meeting conservation (lower) in year 2001 relative to harvests of small salmon and large salmon in the Northwest Miramichi.



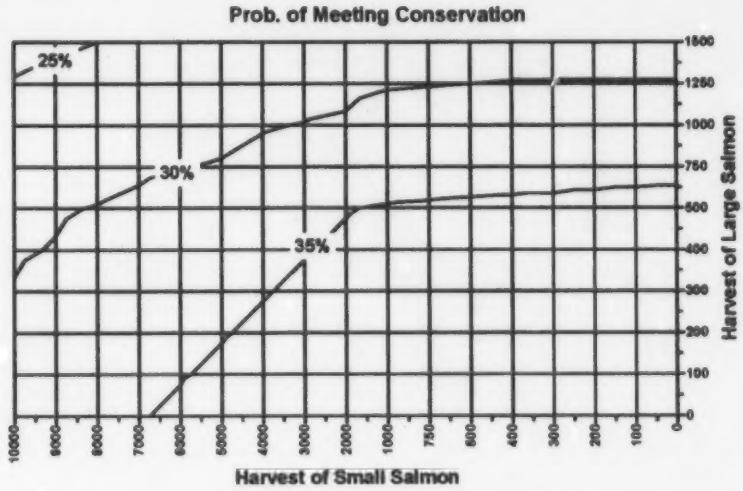


Figure 27. Egg loss expressed as the percentage of the eggs in the total returns of Atlantic salmon to the Southwest Miramichi River (upper) and probability of meeting conservation (lower) in year 2001 relative to harvests of small salmon and large salmon in the Southwest Miramichi.

Appendix 1. Record of client consultation for the Atlantic salmon stock of the Miramichi River.

1. SPECIES / STOCK:

- Atlantic salmon - Miramichi River

2. ARRANGEMENTS:

DATE: December 1, 2000
TIME: 9:30 to 16:00
LOCATION: Atlantic Salmon Museum, Doaktown, New Brunswick

3. FORM OF CONSULTATION (Science Workshop, ZMAC, ETC..)

- Science workshop

4. PARTICIPANTS (Name and Affiliation)

- John Bagnell, AMEC Environmental, Fredericton
- William Basco, Wade's Fishing Lodge, Cains River
- Danny Bird, Atlantic Salmon Federation, St. Andrews, NB
- Daniel Caissie, DFO Science, Moncton
- Gérald Chaput, DFO Science, Moncton
- Kyla Clancy, Miramichi Salmonid Conservation Centre, South Esk
- Chris Connell, J.D. Irving Ltd., Fredericton
- Faye Cowie, NB Aquatic Resources Data Warehouse, Doaktown
- Peter Cronin, Director of Fisheries, Dept. of Natural Resources and Energy (DNRE), Fredericton
- Jason Curtis, Wade's Fishing Lodge, Cains River
- Jerry Doak, WW Doak Fishing Tackle, Doaktown
- Bernie Dubee, Regional Biologist, DNRE, Miramichi City
- Dave Dunn, DFO Fisheries Management, Moncton
- Wayne Fairchild, DFO, Moncton, NB
- John Gilbert, J.D. Irving Limited, Saint John
- Shelley Hackett, J.D. Irving Ltd., Fredericton
- Mark Hambrook, Miramichi Fish Hatchery Inc., South Esk
- Peter Hardie, DFO Science, Moncton
- John Hayward, DFO Science, Miramichi City
- Tim Jardine, MREAC, Miramichi City, NB
- Pierre Mallet, DFO Fisheries Management, Moncton
- Rhonda McLaughlin, Rocky Brook / Bowater Canada, Boiestown
- Dave Moore, DFO Science, Moncton
- Wes Myles, Atlantic Salmon Museum, Doaktown, NB
- Allen O'Donnell, DFO Conservation and Protection, McNamee, NB
- Jocelyn Poissant, DFO/UNB, Moncton
- Manley Price, Rocky Brook Camp / Avenor inc., Boiestown, New Brunswick
- Grant Ross, Miramichi Salmon Association, Boiestown
- Sue Scott, Atlantic Salmon Federation, St. Andrews, NB
- Joe Shaesgreen, DFO Science, Miramichi City
- Chris Smith, J.D. Irving Limited, Hanwell
- Norman Stewart, White Rapids Brook and Other Sreams Enhancement Assoc., Lockstead, NB
- Erin Swansburg, U de Moncton, Moncton, NB
- Vince Swazey, Miramichi Salmon Association, Boiestown, New Brunswick
- Steve Tinker, ASF, St. Andrews, NB
- Fred Whoriskey, Atlantic Salmon Federation, St. Andrews

5. NEW INFORMATION BROUGHT FORWARD

- Angling was slow in June but good through July and August. Angling conditions and catches remained good in Sept. and Oct.
- Crown Reserve angling catches and barrier fence counts (Bernie Dubee, DNRE NB)
- Update on Clearwater Brook project, Chris Connell (ASF/Irving) – preliminary results of PIT tagging of adults to monitor movements within the stream, particularly whether clipped adults resulting from satellite stocking returned to the location of stocking as juveniles
- Presentation by Rhonda McLaughlin and Manley Price, Bowater Canada on installation and operation of rotary screw trap at the mouth of Rocky Brook to monitor movements of presmolts and other fish in the fall.
- Grant Ross: Continuation of MSA juvenile surveys for monitoring satellite stocking areas (in collaboration with DFO)
- Update by Kyla Clancy of collaborative project DFO/MSA looking at seasonal growth of juveniles in relation to temperature and density
- Presentation by Erin Swansburg on analysis of environmental conditions (water temperature and discharge) variation and possible association with juvenile size-at-age (Climate Change Action Fund project)
- Summary of Northwest Miramichi smolt enumeration project for 1998 to 2000 by Gerald Chaput. Collaboration between DFO and Northumberland Salmon Protection Association
- Update from Wayne Fairchild on research associated with endocrine disrupting compounds and salmon smolt growth, survival, physiology
- Update from Peter Hardie on ongoing projects at the Catamaran Brook research project of impacts of forestry activities on the aquatic ecosystem
- Update by Daniel Caissie and Peter Hardie on Environmental Strategic Funds project addressing buffer strip and forestry impact studies

6. CONCERNS RAISED BY CLIENTS (include concerns, plus follow-up action/response made or committed).

-

7. RECOMMENDATIONS:

a.) Pertaining to Assessment

- Angling statistics are incomplete. Voluntary license stub return initiated in 1999 and continued in 2000 has received minimal participation (less than 1000 returns per year). Anticipated that eventually, the stub will be attached to the license.
- Have to show the consequences of warm water conditions on Atlantic salmon especially the trade-off between angler presence on the river versus increased illegal activities when rivers are closed.

b.) Pertaining to next year's workplans

- Continued assessment is required
- Estimates of smolt production from the Miramichi River (not just the Northwest Miramichi) would be a valuable addition to the assessment

Various
NAME OF PRESENTER

Gérald Chaput
NAME OF RAPPORTEUR

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Southwest Miramichi - Small Salmon

		Tagging Area																					
		Southwest Food/Science Lower						Southwest Food/Science Upper						Millerton Trapnet - Southwest Miramichi							
	Tags Placed	June 28	July 364	August 142	Sept 110	Oct 1-15	Total 644	June	July 29	August 119	Sept 273	Oct 1-15	Total 421	May 1	June 28	July 646	August 238	Sept 356	Oct 1-15 162	>Oct 15 3	Total 1434
Recapture Data																					
Percent reported																					
Angling	Total	10.7%	5.2%	2.8%	3.6%		4.7%		0.0%	2.5%	3.3%		2.9%	0.0%	7.1%	6.8%	5.0%	2.5%	0.0%	0.0%	4.7%
Traps	NW	14.3%	9.3%	2.8%	1.8%		6.8%		0.0%	4.2%	1.8%		2.4%	0.0%	0.0%	0.6%	0.4%	1.4%	1.9%	0.0%	0.9%
	SW	0.0%	8.2%	7.0%	14.5%		8.7%		3.4%	16.8%	13.9%		14.0%	0.0%	0.0%	3.3%	7.1%	6.7%	11.1%	0.0%	5.6%
Angling Recaptures																					
In Southwest																					
	Unknown	2	17	4	4	0	27	0	0	3	9	0	12	0	2	42	12	9	0	0	66
	June						0						0								0
	July	1	8	1			0						0								0
	August	1	4	1			10						0		1	15					16
	Sept.		5	1	3		6			1			1		1	22	4				27
	Oct			1	1		9			2	6		8			3	4	5			12
							2				3		3			2	4	4			10
In Northwest																					
	Unknown	1	2	0	0	0	3	0	0	0	0	0	0	0	0	2	0	0	0	0	2
	June						0						0								0
	July	1	1				0						0								0
	August		1				2						0			1					1
	Sept.						1						0			1					1
	Oct						0						0								0
							0						0								0
Miramichi	Unknown						0						0								0
Mortalities recovered upriver (in freshwater)																					
Northwest							0						0								0
Southwest							0						0								0
Unmarked fish recovered at facility above		45	376	150	111		682	72	394	261	274		911	1	28	650	240	356	163	4	1442
Mortalities at facility above		2					2	1		1	1		3			1				1	2
Fish with tagging scars recovered at facility above							0						0								0
Recaptured fish lost before reading tag number at facility above							0						0								0

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

[illegible]

Tagging Area																							
	Southwest Fredericton Lower							Southwest Fredericton Upper							Millerton Tributary - Southwest Miramichi								
	June	July	August	Sept	Oct 1-15	Total	June	July	August	Sept	Oct 1-15	Total	May	June	July	August	Sept	Oct 1-15	>Oct 15	Total
Tags Placed	29	354	142	110		640		29	119	273		421	1	35	649	236	356	162	3	1436
Recoveries of tags placed at fishing stations																				
Northwest Fredericton Tributary	0	3	0	0	0	3	0	0	0	1	0	1	0	0	0	0	1	0	0	1
June						0						0								0
July		3				3						0								0
August						0						0								0
Sept						0				1		1					1			1
Oct 1-15						0						0								0
Northwest Cassilis Tributary	1	14	1	2	0	18	0	0	1	3	0	4	0	0	2	1	4	3	0	10
June	1					1						0								0
July		10				10						0			1					1
August		2				2						0								0
Sept		2		2		4			1	1		2				1				1
Oct 1-15			1			1				2		2			1		4	2		7
>Oct 15						0						0						1		1
Red Bank Tributary	3	17	3	0	0	23	0	0	4	1	0	5	0	0	2	0	0	0	0	2
June						0						0								0
July	2	8				10						0								0
August	1	6	1			8			2			2			2					2
Sept		3	2			5			2	1		3								0
Oct 1-15						0						0								0
Big Hole Pulpit Forest	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June						0						0								0
July						0						0								0
August						0						0								0
Sept						0						0								0
Oct 1-15						0						0								0
Southwest Fredericton Lower	0	7	1	1	0	9	0	0	0	3	0	3	0	0	0	1	1	0	0	2
June						0						0								0
July		6				6						0								0
August		1	1			2						0				1	1			2
Sept				1		1				3		3								0
Oct 1-15						0						0								0
Southwest Fredericton Upper	0	10	6	6	0	24	0	0	0	10	0	10	0	0	1	3	5	0	0	9
June						0						0								0
July		9				9						0			1					1
August			6			6			6			6				1				1
Sept		1		6		9			2	10		12				2	5			7
Oct 1-15						0						0								0
Southwest Millerton Tributary	0	13	3	7	0	23	0	1	12	19	0	32	0	0	20	13	19	10	0	62
May						0						0								0
June						0						0								0
July		17				17		1				1			14					14
August		1	3			4			8			8				7				7
Sept				6		6			4	16		20			2	4	9			15
Oct 1-15				1		1				3		3			4	2	9	10		25
>Oct 15						0						0								0
Quebec Forests	2	0	1	1	0	10	0	1	1	6	0	8	0	0	14	6	15	1	0	46
NW Miramichi June-Aug	1					1						0								0
Sept-Oct						0						0								0
Catamaran June-Aug						0						0								0
Sept-Nov						0			1	1		2				7				7
Dungarvon June-Aug		1				1						0			1					1
Sept-Oct						0				2		2			1		2			3
Clearwater Brook June-Aug						0						0			1					1
Sept-Nov		3				3		1				1		1	3	3	7			13
Rankin Brook June-Aug						0						0								0
Sept-Nov		2	1			3				2		2			2	2	6	1		11
SW Miramichi June-Aug	1	1				2				0		0		2	4					6
Sept-Oct		1		1		2				1		1			3	3				6
Greenhead Stocking	0	3	0	0	0	3	0	0	0	1	0	1	0	0	2	1	2	0	0	4
Portage						0						0								0
Dungarvon						0				1		1			2		2			4
Southwest		3				3						0								0
Little Southwest						0						0								0
Sevogle						0						0								0
Northwest						0						0								0

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Southwest Miramichi - Large Salmon

		Tagging Area																			
		Southwest Food/Science Lower						Southwest Food/Science Upper						Millerton Trapnet - Southwest Miramichi							
		June	July	August	Sept	Oct 1-15	Total	June	July	August	Sept	Oct 1-15	Total	May	June	July	August	Sept	Oct 1-15	>Oct 15	Total
	Tags Placed	2	68	27	30		**127**	7	56	67	98		**228**		9	104	72	109	81	7	**382**
Recapture Data																					
Percent reported																					
Angling	Total	0.0%	1.5%	0.0%	3.3%		1.6%	0.0%	1.8%	0.0%	2.0%		1.3%		0.0%	1.0%	1.4%	0.9%	0.0%	0.0%	0.8%
Traps	NW	0.0%	2.9%	3.7%	0.0%		2.4%	14.3%	1.8%	6.0%	5.1%		4.8%		11.1%	0.0%	0.0%	1.8%	0.0%	0.0%	0.8%
	SW	0.0%	2.9%	3.7%	6.7%		3.9%	0.0%	3.6%	11.9%	10.2%		8.8%		0.0%	1.9%	2.8%	8.3%	6.2%	0.0%	4.7%
Angling Recaptures																					
In Southwest		0	1	0	0	0	**1**	0	1	0	2	0	**3**	0	0	1	1	1	0	0	**3**
	Unknown						0						0								0
	June						0						0								0
	July						0						0								0
	August		1				1		1				1								0
	Sept						0				2		2			1	1				2
	Oct						0						0					1			1
In Northwest		0	0	0	0	0	**0**	0	0	0	0	0	**0**	0	0	0	0	0	0	0	**0**
	Unknown						0						0								0
	June						0						0								0
	July						0						0								0
	August						0						0								0
	Sept						0						0								0
	Oct						0						0								0
Miramichi	Unknown				1		**1**						**0**								**0**
Mortalities recovered upriver (in freshwater)																					
Northwest							**0**						**0**								**0**
Southwest							**0**						**0**								**0**
Unmarked fish recovered at facility above		18	74	33	30		**155**	21	58	74	98		**249**	1	15	108	73	109	82	7	**395**
Mortalities at facility above		4	1	1			**6**	3					**3**		3	3	3		1		**10**
Fish with tagging scars recovered at facility above			1				**1**						**0**				2				**2**
Recaptured fish lost before reading tag number at facility above							**0**						**0**								**0**

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Southwest Miramichi Large Salmon

Tagging Area

	Southwest Pond/Dickson Lower						Southwest Pond/Dickson Upper						Millerton Trapnet - Southwest Miramichi							
	June	July	August	Sept	Oct 1-15	Total	June	July	August	Sept	Oct 1-15	Total	May	June	July	August	Sept	Oct 1-15	>Oct 15	Total
Tags Placed	2	69	27	30		127	7	58	67	98		230		8	104	72	109	61	7	362
Recoveries of tags placed at facility above																				
Northwest Pond/Dickson Trapnet	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0
June						0						0								0
July						0						0								0
August						0						0								0
Sept						0				1		1								0
Oct 1-15						0						0								0
Northwest Cassilis Trapnet	0	1	0	0	0	1	0	1	2	4	0	7	0	0	0	0	2	0	0	2
June						0						0								0
July						0						0								0
August		1				1			1			1								0
Sept						0			1	2		3					1			1
Oct 1-15						0		1		2		3					1			1
>Oct 15						0						0								0
Red Bank Trapnets	0	1	1	0	0	2	1	0	2	0	0	3	0	1	0	0	0	0	0	1
June						0						0								0
July						0	1					1								0
August		1				1			2			2		1						1
Sept			1			1						0								0
Oct 1-15						0						0								0
Big Hole Picket Fence	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
June						0						0								0
July						0						0								0
August						0						0								0
Sept						0						0								0
Oct 1-15						0						0								0
Southwest Pond/Dickson Lower	0	0	0	0	0	0	0	1	1	2	0	4	0	0	0	0	0	0	0	0
June						0						0								0
July						0		1				1								0
August						0						0								0
Sept						0			1	2		3								0
Oct 1-15						0						0								0
Southwest Pond/Dickson Upper	0	1	1	1	0	3	0	1	3	5	0	9	0	0	0	0	1	0	0	1
June						0						0								0
July		1				1		1				1								0
August			1			1			1			1								0
Sept				1		1			2	5		7					1			1
Oct 1-15						0						0								0
Southwest Millerton Trapnet	0	1	0	1	0	2	0	0	4	3	0	7	0	0	2	2	6	5	0	17
May						0						0								0
June						0						0								0
July						0						0			2					2
August						0			3			3				1				1
Sept				1		1			1	2		3				1	3			4
Oct 1-15		1				1				1		1					5	5		10
>Oct 15						0						0								0
Barrier Fences	0	0	0	0	0	0	0	1	0	0	0	1	0	0	4	4	4	2	0	14
NW Miramichi	June-Aug					0						0								0
	Sept-Oct					0						0								0
Catamaran	June-Aug					0						0								0
	Sept-Nov					0						0								0
Dungarvon	June-Aug					0						0								0
	Sept-Oct					0						0								0
Clearwater Brook	June-Aug		1			1						0					1			1
	Sept-Nov					0						0								0
Burnt Hill Brook	June-Aug					0						0				3	1			4
	Sept-Nov					0						0								0
SW Miramichi	June-Aug		1			1		1				1			3		1	1		5
	Sept-Oct					0						0								0
			1			1						0			1	1	1	1		4
Groundfish Gaming	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Renous						0						0								0
Dungarvon						0						0								0
Southwest						0						0								0
Little Southwest						0						0								0
Sevogle						0						0								0
Northwest						0						0								0

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Northwest Miramichi - Small Salmon

		Tagging Area: Northwest Food/Science Trapnet							Castalis Trapnet - Northwest Miramichi						
		June	July	August	Sept	Oct 1-15	Total		June	July	August	Sept	Oct 1-15	>Oct 15	Total
Tags Placed				29	41		70		72	527	167	171	133	6	**1076**
Recapture Data															
Percent reported															
Angling	Total			0.0%	4.9%		2.9%		4.2%	4.7%	3.6%	1.8%	0.0%	0.0%	3.4%
Traps	NW			27.6%	22.0%		24.3%		6.9%	17.3%	41.9%	21.6%	10.5%	0.0%	20.2%
	SW			0.0%	2.4%		1.4%		1.4%	0.9%	1.8%	2.3%	2.3%	0.0%	1.5%
Angling Recaptures															
In Southwest		0	0	0	1	0	**1**		1	1	2	1	0	0	**6**
	Unknown						0								0
	June						0								0
	July						0		1						1
	August						0			1					1
	Sept						0				1				1
	Oct				1		1				1	1			2
In Northwest		0	0	0	1	0	**1**		2	23	4	2	0	0	**31**
	Unknown						0								0
	June						0								0
	July						0		1	12					13
	August						0		1	10	2				13
	Sept.				1		1			1	2				3
	Oct						0					2			2
Miramichi							**0**			1					**1**
Mortalities recovered upriver (in freshwater)															
Northwest							**0**								**0**
Southwest							**0**								**0**
Unmarked fish recovered at facility above		61	174	59	54		**348**		82	528	168	172	134	6	**1090**
Mortalities at facility above		2					**2**		7						**7**
Fish with tagging scars recovered at facility above							**0**			1					**1**
Recaptured fish lost before reading tag number at facility above				1			**1**								**0**

Red Bank Trapnets - Northwest Miramichi

	June	July	August	Sept	Oct 1-15	Total
Unmarked fish recovered at facility	388	726	506	367	31	**2018**
Fish with tagging scars recovered at facility		1				**1**
Recaptured fish lost before reading tag number at facility above		1		1		**2**
Mortalities at facility above	10	2				**12**

Big Hole Partial Fence

	June	July	August	Sept	Oct 1-15	Total
Unmarked fish recovered at facility						**0**
Fish with tagging scars recovered at facility						**0**
Recaptured fish lost before reading tag number at facility above						**0**

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Northwest Miramichi - Small Salmon

	Tagging Area: Northwest Food/Science Trapnet						Casolle Trapnet - Northwest Miramichi						
	June	July	August	Sept.	Oct. 1-15	Total	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
Tags Placed	.	.	29	41	.	**70**	72	527	167	171	133	6	**1076**
Recoveries of tags at facility													
Northwest Food/Science Trapnet	0	0	1	2	0	**3**	0	3	0	0	0	0	**3**
June	.	.	.		.	0	.	.		.		.	0
July		.	.			0	.	3					3
August		.	1		.	1	.						0
Sept		.	.	2	.	2	.						0
Oct. 1-15		.	.		.	0	.						0
Northwest Casolle Trapnet	0	0	3	4	0	**7**	2	21	12	25	14	0	**74**
June		.	.		.	0	.			.		.	0
July		.	.	.	.	0	1	20		.		.	21
August		.	.		.	0	.	1	5	.		.	6
Sept			2	4		6	1		7	13			21
Oct. 1-15			1		.	1				12	11		23
> Oct. 15						0					3		3
Red Bank Trapnets	0	0	4	3	0	**7**	3	67	58	12	0	0	**140**
June	.	.	.		.	0	1	.		.		.	1
July		.	.		.	0	1	55		.		.	56
August		.	2		.	2	1	9	48	.		.	58
Sept		.	2	3	.	5	.	3	10	12		.	25
Oct. 1-15		.				0							0
Big Hole Patial Fence	0	0	0	0	0	**0**	0	0	0	0	0	0	**0**
June		.	.		.	0	.	.		.		.	0
July		.	.	.	.	0	.	.		.		.	0
August		.	.	.	.	0	.	.		.		.	0
Sept		.	.		.	0	.	.		.		.	0
Oct. 1-15		.	.		.	0	.	.		.		.	0
Southwest Food/Science Lower	0	0	0	0	0	**0**	1	1	0	0	0	0	**2**
June		.	.		.	0	.	.		.		.	0
July		.	.		.	0	1						1
August		.	.		.	0	.	.		.		.	0
Sept.		.	.		.	0	.	1		.		.	1
Oct. 1-15		.	.		.	0	.	.		.		.	0
Southwest Food/Science Upper	0	0	0	1	0	**1**	0	1	1	0	0	0	**2**
June		.	.		.	0	.	.		.		.	0
July						0		1					1
August						0							0
Sept.			.	1	.	1	.	.	1	.		.	1
Oct. 1-15						0							0
Southwest Millertnn Trapnet	0	0	0	0	0	**0**	0	3	2	4	3	0	**12**
May		.	.		.	0	.	.		.		.	0
June		.	.		.	0	.	.		.		.	0
July						0		2					2
August						0							0
Sept						0			2	2			4
Oct. 1-15						0		1		2	3		6
> Oct. 15						0							0
Barrier Fences	0	0	0	0	0	**0**	2	6	2	6	4	0	**20**
NW Miramichi June-Aug.		.	.		.	0	1	.		.		.	1
Sept.-Oct.		.	.		.	0	1	.		.		.	1
Catamaran June-Aug.						0							0
Sept.-Nov						0		2	2		3		7
Dungarvon June-Aug						0							0
Sept.-Oct						0							0
Clearwater Broc June-Aug						0							0
Sept.-Nov						0		1		2			3
Burnthill Brook June-Aug						0							0
Sept.-Nov						0				4	1		5
SW Miramichi June-Aug						0							0
Sept.-Oct.		.	.		.	0	.	3		.			3
Broodstock Seining	0	0	0	0	0	**0**	0	1	1	0	0	0	**2**
Renous		.	.		.	0	.	.		.		.	0
Dungarvon						0			1				1
Southwest						0							0
Little Southwest						0		1					1
Sevogle						0							0
Northwest						0							0

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Northwest Miramichi - Large Salmon

		Tagging Area: Northwest Food/Science Trapnet						Caselle Trapnet - Northwest Miramichi						
		June	July	August	Sept.	Oct. 1-15	Total	June	July	August	Sept.	Oct. 1-15	>Oct. 15	Total
	Tags Placed	1	43	20	14		**78**	10	75	49	71	67	4	**276**
Recapture Data														
Percent reported														
Angling	Total	0.0%	4.7%	0.0%	0.0%		2.6%	0.0%	0.0%	2.0%	1.4%	1.5%	0.0%	1.1%
Traps	NW	0.0%	11.6%	5.0%	0.0%		7.7%	10.0%	13.3%	24.5%	12.7%	7.5%	0.0%	13.4%
	SW	0.0%	4.7%	10.0%	21.4%		9.0%	10.0%	2.7%	2.0%	2.8%	3.0%	0.0%	2.9%
Angling Recaptures														
In Southwest		0	0	0	0	0	**0**	0	0	0	1	0	0	**1**
	Unknown						0		.	.	.	.	.	0
	June						0							0
	July						0							0
	August						0							0
	Sept						0							0
	Oct						0				1			1
In Northwest		0	2	0	0	0	**2**	0	0	1	0	1	0	**2**
	Unknown						0		.	.	.	.	.	0
	June						0		.	.	.	.	.	0
	July						0		.	.	.	.	.	0
	August						0		.	.	.	.	.	0
	Sept		2				2							0
	Oct						0		.	1	.	1	.	2
Miramichi							**0**		.	.	.	.	.	0
Mortalities recovered upriver (in freshwater)														
Northwest							**0**							**0**
Southwest							**0**		.	.	.	.	.	**0**
Unmarked fish recovered at facility above		19	43	23	14		**99**	10	75	51	71	67	4	**278**
Mortalities at facility above							**0**		.	1	.	.	.	**1**
Fish with tagging scars recovered at facility above							**0**		.	.	.	.	.	**0**
Recaptured fish lost before reading tag number at facility above							**0**		.	.	.	.	.	**0**

Red Bank Trapnets - Northwest Miramichi

	June	July	August	Sept.	Oct. 1-15	Total
Unmarked fish recovered at facility	104	130	220	144	15	**613**
Fish with tagging scars recovered at facility						**0**
Recaptured fish lost before reading tag number at facility above						**0**
Mortalities at facility above	5	4	1			**9**

Big Hole Partial Fence

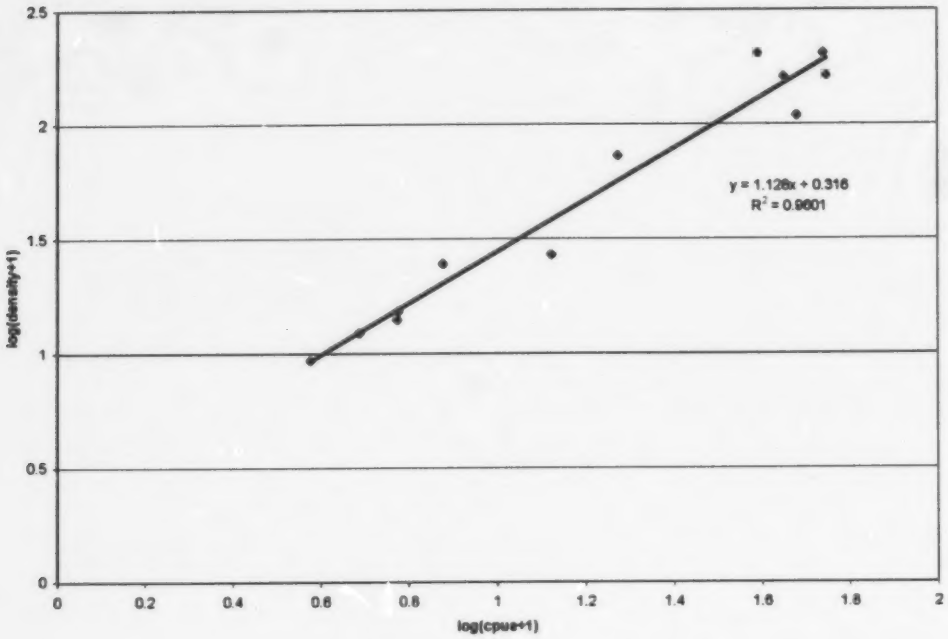
	June	July	August	Sept.	Oct. 1-15	Total
Unmarked fish recovered at facility						**0**
Fish with tagging scars recovered at facility						**0**
Recaptured fish lost before reading tag number at facility above						**0**

Appendix 2. Marking, recapture and fish sampling from Miramichi in 2000.

Northwest Miramichi - Large Salmon

	Tagging Area												
	Northwest Food/Science Trapnet							Casalis Trapnet - Northwest Miramichi						
	June	July	August	Sept	Oct 1-15		Total	June	July	August	Sept	Oct 1-15	>Oct. 15	Total
Tags Placed	1	43	20	14			**78**	10	75	49	71	67	4	**276**
Recoveries of tags at facility														
Northwest Food/Science Trapnet	0	0	0	0	0		**0**	0	0	0	1	0	0	**1**
June		.	.	.	.		0	.	.	.	.			0
July	.	.	.	.	.		0	.	.	.	.			0
August		.	.	.	.		0	.	.	.	.			0
Sept.		.	.	.	.		0	.	.	.	1			1
Oct. 1-15		.	.	.	.		0	.	.	.	.			0
Northwest Casalis Trapnet	0	1	1	0	0		**2**	1	4	3	5	5	0	**18**
June							0							0
July		1		.			1	1	1					2
August		.	1	.	.		1	.	1	1	.			2
Sept.		.	.	.	.		0	.	2	2	4			8
Oct. 1-15							0				1	3		4
> Oct. 15							0					2		2
Red Bank Trapnets	0	4	0	0	0		**4**	0	6	6	3	0	0	**18**
June		.	.	.	.		0	.	.	.	.			0
July		3	.	.	.		3	.	3	.	.			3
August							0		3	6				9
Sept		1					1			3	3			6
Oct. 1-15		.	.	.	.		0	.	.	.	.			0
Big Hole Patial Fence	0	0	0	0	0		**0**	0	0	0	0	0	0	**0**
June							0							0
July							0							0
August		.	.	.	.		0	.	.	.	.			0
Sept.		.	.	.	.		0	.	.	.	.			0
Oct. 1-15							0							0
Southwest Food/Science Lower	0	0	0	1	0		**1**	0	1	0	1	0	0	**2**
June							0							0
July							0							0
August		.	.	.	.		0	.	.	.	.			0
Sept				1			1		1		1			2
Oct. 1-15							0							0
Southwest Food/Science Upper	0	1	0	2	0		**3**	1	1	0	1	0	0	**3**
June							0							0
July		1					1							0
August							0	1						1
Sept				2			2		1		1			2
Oct. 1-15		.	.	.	.		0	.	.	.	.			0
Southwest Millerton Trapnet	0	1	2	0	0		**3**	0	0	1	0	2	0	**3**
May							0							0
June							0							0
July		1	.	.	.		1	.	.	.				0
August		.	.	.	.		0	.	.	.	.			0
Sept			2		.		2			1				1
Oct. 1-15		.	.	.	.		0	.	.	.	.	1		1
> Oct. 15		.	.	.	.		0	.	.	.	.	1		1
Barrier Fences	0	1	1	2	0		**4**	0	3	2	3	1	0	**9**
NW Miramichi June-Aug							0							0
Sept.-Oct							0							0
Catamaran June-Aug.		.	.	.	.		0	.	.	.	.			0
Sept.-Nov		.	.	.	.		0	.	.	.	.			0
Dungarvon June-Aug							0							0
Sept.-Oct							0							0
Clearwater Broc June-Aug.		.	.	.	.		0	.	.	.				0
Sept.-Nov		1	.	.	.		1	.	.	1	2			3
Burnhill Brook June-Aug							0							0
Sept.-Nov			1	1			2		2	1		1		4
SW Miramichi June-Aug.		.	.	.	.		0	.	.	.				0
Sept.-Oct.		.	.	1	.		1	.	1	.	1			2
Broodstock Seining	0	0	0	0	0		**0**	1	0	0	0	0	0	**1**
Renous		.	.	.	.		0	.	.	.	.			0
Dungarvon		.	.	.	.		0	.	.	.	.			0
Southwest		.	.	.	.		0	1	.	.	.			1
Little Southwest							0							0
Sevogle							0							0
Northwest		.	.	.	.		0	.	.	.	.			0

Appendix 3. Juvenile survey CPUE to density calibration for the Miramichi River for 2000. The twelve points on the graph are the CPUE and density values for fry as well as parr collected from the six closed sites. CPUE is expressed as fish per 180 seconds of fishing effort, density expressed as fish per 100 m^2.



Appendix 4. Detailed distributions records of Atlantic salmon from the Miramichi Salmon Conservation Center, South Esk, NB, 2000.

Site Code	LOCATION	dd	mm	yr	Lat	Long	Mark	SPC.	STOCK	RIVER	Program	Stage	#FISH
219300	LSW Mir. - Devils Brook	15	6	2000	4653	6613	NM	J	LSW Mir.	NW	Hatchery	0+ Parr	2,745
219307	LSW Mir. - Libbies Brook	15	6	2000	4654	6624	NM	J	LSW Mir.	NW	Hatchery	0+ Parr	2,745
219319	LSW Mir. - Symth Forks	15	6	2000	4658	6635	NM	J	LSW Mir.	NW	Hatchery	0+ Parr	5,490
	LSW Mir. - Upper West Branch	15	6	2000	4701	6643	NM	J	LSW Mir.	NW	Hatchery	0+ Parr	5,490
219255	Northwest Miramichi - Camp Adam	15	9	2000	4711	6608	AC	J	NW Mir.	NW	Satellite	0+ Parr	4,590
228215	Gilman Brook,	29	9	2000	4636	6642	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	4,719
	Main Southwest Miramichi R. (3 sites)	29	9	2000	4636	6642	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	4,719
219062	Black Brook	2	10	2000	4640	6547	AC	J	Cains	SW	Satellite	0+ Parr	4,822
	N.E. Clearwater - Main Road	4	10	2000	4649	6656	AC	J	Clearwater	SW	Satellite	0+ Parr	4,843
	N.E. Clearwater - Main Road	4	10	2000	4649	6656	AC	J	Clearwater	SW	Satellite	0+ Parr	3,047
	Six Mile Brook (East & Middle)	5	10	2000	4631	6551	AC	J	Cains	SW	Satellite	0+ Parr	4,823
	Main Southwest Miramichi (Salmon Brook)	9	10	2000	4633	6633	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	2,497
	Salmon Brook (2 sites)	9	10	2000	4633	6633	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	2,497
	Astle Brook, SW Mir., Barnettville	10	10	2000	4646	6547	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	1,206
219038	Cains R - Camp Admerrill Camp	10	10	2000	4639	6577	AC	J	Cains	SW	Satellite	0+ Parr	1,100
219038	Cains R. - Mouth of Cains R.	10	10	2000	4640	6577	AC	J	Cains	SW	Satellite	0+ Parr	1,000
219038	Cains R. - Salmon Brk, Acadia Rd.	10	10	2000	4637	6571	AC	J	Cains	SW	Satellite	0+ Parr	1,654
219038	Cains R. - Salmon Brk Bridge	10	10	2000	4637	6571	AC	J	Cains	SW	Satellite	0+ Parr	1,000
	Donnely Brook	10	10	2000	4636	6653	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	2,200
219041	Main Southwest Miramichi, Ludlow	10	10	2000	4629	6622	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	1,387
219065	SW Miramichi, Morse Brook	10	10	2000	4642	6547	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	2,000
219062	Mountain Channel Brook	10	10	2000	4628	6623	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	1,500
	White Rapids Brook	10	10	2000	4648	6547	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	1,200
230124	Clearwater - Frasers Rd. (Old bridge)	11	10	2000	4647	6652	AC	J	Clearwater	SW	Satellite	0+ Parr	6,000
230124	Clearwater - N.N. 15 Flagged Road	11	10	2000	4647	6652	AC	J	Clearwater	SW	Satellite	0+ Parr	3,000
219330	Guagus stream, Lower North Br. Little SW Miramichi	13	10	2000	4658	6623	AC	J	LSW Mir.	NW	Satellite	0+ Parr	3,100
219319	Little Southwest Miramichi	13	10	2000	4658	6635	AC	J	LSW Mir.	NW	Satellite	0+ Parr	3,100
219303	LSW Mir. - Tuadook	13	10	2000	4658	6634	AC	J	LSW Mir.	NW	Satellite	0+ Parr	3,100
228219	Slate Island Brook	16	10	2000	4632	6688	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	4,870
230124	Clearwater - N.N. 15 Flagged Road	18	10	2000	4647	6652	AC	J	Clearwater	SW	Satellite	0+ Parr	3,000
230124	Clearwater - P.P. Road (4 sites)	18	10	2000	4647	6652	AC	J	Clearwater	SW	Satellite	0+ Parr	6,000
219293	Renous R. - Duffy Brook	18	10	2000	4648	6552	NM	J	Dungarvon	SW	Satellite	0+ Parr	4,500
219325	Harris Brook (Ludlow)	20	10	2000	4628	6621	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	1,400
219041	Main Southwest Miramichi R. (Ludlow, 4 sites)	20	10	2000	4629	6635	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	2,800
219328	Mamies Brook, Ludlow	20	10	2000	4629	6621	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	790
	Renous R. - Mouth of Johnson Brook	25	10	2000	4649	6555	AC	J	Dungarvon	SW	Satellite	0+ Parr	5,000
219196	Rocky Brook - Fish Brook	25	10	2000	4645	6641	AC	J	Rocky Brook	SW	Satellite	0+ Parr	9,753
230124	Clearwater - P.P. Road	26	10	2000	4647	6652	AC	J	Clearwater	SW	Satellite	0+ Parr	5,000
230121	Clearwater - Renous Hwy (2 sites)	26	10	2000	4652	6653	AC	J	Clearwater	SW	Satellite	0+ Parr	4,000
	LSW Mir. - Parks Brook	7	11	2000	4654	6609	AC	J	LSW Mir.	NW	Hatchery	0+ Parr	1,200
219196	Rocky Brook - L.L. Road	7	11	2000	4647	6643	AC	J	Rocky Brook	SW	Satellite	0+ Parr	4,675
229030	Little Teague	11	11	2000	4633	6714	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	7,250
	Main Southwest Miramichi, S. Branch	11	11	2000	4633	6710	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	5,400
	Big Teague	11	11	2000	4633	6714	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	5,400
229014	Elliot Brook	11	11	2000	4634	6717	AC	J	Main SW Mir.	SW	Satellite	0+ Parr	5,400
219196	Rocky Brook - L.L. Road	15	11	2000	4647	6643	AC	J	Rocky Brook	SW	Satellite	0+ Parr	4,675
	South Br. Northwest Miramichi Spruce Lake Rd.	20	11	2000	4715	6623	AC	J	NW Mir.	NW	Satellite	0+ Parr	8,150
219149	North Br. Northwest Miramichi	20	11	2000	4716	6625	AC	J	NW Mir.	NW	Satellite	0+ Parr	8,150
219085	North Br. Tomogonops	20	11	2000	4714	6550	AC	J	NW Mir.	NW	Satellite	0+ Parr	3,788
219241	N. Br. Little River	20	11	2000	4714	6604	AC	J	NW Mir.	NW	Satellite	0+ Parr	3,788
	Hudson Brook, SW Mir. Underhill	27	11	2000	4645	6549	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	1,000
	Beckettts Brook, SW Mir. Blackville	27	11	2000	4643	6549	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	1,000
219299	McKenzie Brook, SW Mir. acr. from Keenan Siding	27	11	2000	4642	6547	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	1,000
	Doctor's Island, SW Mir. - Blackville	27	11	2000	4644	6550	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	11,000
	Above Upper Blackville Bridge, SW Mir.	27	11	2000	4637	6552	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	14,000
	Doak Brook, SW mir. - Doaktown	27	11	2000	4633	6607	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	500
	Crooked Bridge Brook, SW Mir. - Ludlow	27	11	2000	4634	6615	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	2,000
	Below Porter Cove Bridge, SW Mir. Porter Cove	27	11	2000	4628	6624	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	4,000
219036	North Br. Betts Mill Brook, SW Mir. - Nelson Hollow	27	11	2000	4631	6607	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	500
219036	South Br. Betts Mill Brook, SW Mir. - Nelson Hollow	27	11	2000	4631	6607	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	500
	East Br. Burntland Brook	27	11	2000	4625	6620	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	500
	Above Norrads Bridge, SW Mir. - Bloomfield Rdg.	27	11	2000	4629	6628	AC	J	Main SW Mir.	SW	Hatchery	0+ Parr	2,000
219315	Dungarvon River - Russell & Swim Bridge	4	12	2000	4640	6619	AC	J	Dungarvon	SW	Hatchery	0+ Parr	2,322
219046	Dungarvon River - Furlong Bridge	4	12	2000	4644	6601	AC	J	Dungarvon	SW	Hatchery	0+ Parr	2,322
Total													233,207

Codes: SPC: A - Smolts
J - Non-smolts

Mark - AC; adipose clip
- NM; no mark